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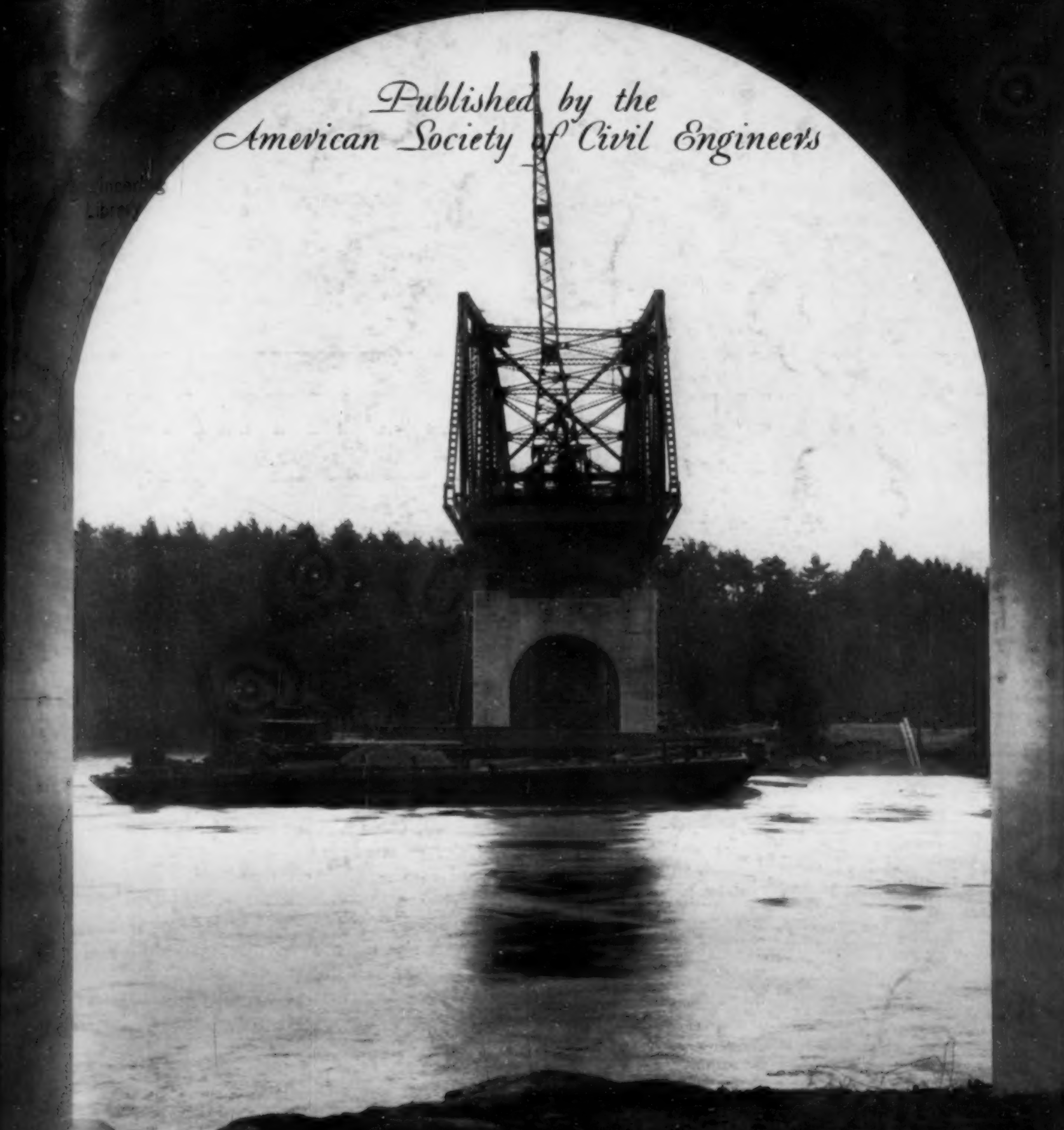

Volume 8 — *Number 11*

AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

NOVEMBER 1938

Among Our Writers

THOMAS R. AGG, a Director of the Society, was graduated in 1905 from Iowa State College, where he is now dean of engineering and director of the engineering experiment station. He has specialized in highway work and has been a member of the executive committee of the Highway Research Board since 1924.

WILLIAM T. FIELD has been in private practice in Watertown, N.Y., since 1910, specializing in general municipal work and structural design. For several years he has been on the legislative committee of the Conference of Mayors of the State of New York.

EDWARD H. SARGENT (Massachusetts Institute of Technology, 1907) has been chief engineer of the Hudson River Regulating District since 1923, and is also a consultant on hydraulic and power projects. In 1921 he was in charge of the Water Power Bureau of the New York State Engineering Department.

W. A. ROUNDS, land engineer for the Continental Oil Company, in charge of land surveying for Texas and Louisiana, has been with that organization for 11 years. He is a native Texan and a resident of Houston.

HARLEY B. FERGUSON has served with the Corps of Engineers since his graduation from West Point in 1897. Early in his career he had charge of raising the battleship *Maine*, and the originality he displayed on that occasion has characterized his work in many later assignments. He became president of the Mississippi River Commission in 1932, immediately instigated the program of cut-offs, and is the originator of the corrective dredging technique that has contributed so materially to its success.

ROBINS FLEMING has had a long career in structural steel design. Since his retirement in 1931 he has applied himself to his hobby of library research, and has contributed a wide variety of brief articles to the technical press.

A. W. WALKER received his B. S. degree from Massachusetts Institute of Technology in 1905. His irrigation experience dates from the same year, when he entered the U. S. Reclamation Service—forerunner of the Bureau of Reclamation—as an engineering aid.

LACEY V. MURROW, with the Washington Highway Department since 1919, became its director in 1933. He is a member of the executive committee of the American Association of State Highway Officials.

BERTRAM H. LINDMAN since 1933 has directed the research activities of the Washington Highway Transportation Commission and its predecessor, the Highway Cost Commission. Previously he served on the staffs of the Interstate Commerce Commission, the Bureau of Public Roads, and the Federal Coordinator of Transportation.

ALTON C. CHICK (Brown University, 1919) was principal assistant to the late John R. Freeman from 1922 to 1932, and had an active part in the design of the National Hydraulic Laboratory and several hydroelectric projects. Since 1932 he has been with the Manufacturers' Mutual (Group) Fire Insurance Co.

A. F. DAPPERT graduated from the University of Illinois in 1920, served with the Illinois State Department of Public Health for some time, took graduate work at Harvard in 1927, and became principal sanitary engineer of the New York State Department of Health in 1930.

F. W. CRON (University of Michigan, 1928) has been with the Bureau of Public Roads almost continuously since graduation, on such projects as the Mt. Vernon Memorial Highway and park roads in the Great Smoky Mountains and various military parks.

HARRY E. ECKLES, an 1898 graduate of the University of Illinois, has had some 30 years' experience in structural design and construction. He has designed many retaining walls for Illinois highways, and, earlier, for the Kansas City Terminal Railway.

GREGORY P. TSCHEBOTAREFF graduated in 1925 at the Technische Hochschule, Berlin-Charlottenburg. He worked for 3 years in Germany as structural engineer, then served 7 years with the Egyptian Government in engineering work. He was called to Princeton in 1937.

JEROME FEE (University of California, 1914) has been with the San Francisco Water Department for 5 years. Earlier experience includes about 12 years of field engineering in connection with hydroelectric and irrigation projects in California.

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Something to Think About

A Series of Reflective Comments Sponsored by the Committee on Publications

Engineering in This New Era

From an Address at the Student Chapter Luncheon, Society Meeting, Jacksonville, Fla.

By T. R. Agg, M. Am. Soc. C.E.
Dean of Engineering, Iowa State College, Ames, Iowa

NEW eras have come and gone since the dawn of history; the fact that we are now said to be in a new era should of itself create no uneasiness. Changes have always been under way in the complex interrelationships of human beings and in the agencies of government created by, or forced upon, society. Those with which the whole world is wrestling today are but the natural outgrowth of the inability of the social organization to adjust itself with sufficient rapidity to progress in improving the man-made physical appurtenances to our mode of living.

For two centuries engineering has piloted the evolution in the physical equipment intended to lighten human labor and enhance the comfort and pleasure of living. Today, professional engineers, like all other elements of the population, are trying to find the best personal adjustment to life in a world that is changing rapidly under the impetus of science and invention. It seems appropriate to review briefly the trend of events in the long struggle of human beings to better their lot, in order that the historical roots of engineering may be understood.

Increasing Accomplishments.~The world has been populated for a long time; just how long, of course, nobody can be sure, but fairly reliable estimates indicate that human beings of a sort have lived on the earth for at least 200,000 years. This long period may be divided into four significant eras: (1) the era of savagery, 190,000 years; (2) the era of barbarism, 7,500 years; (3) the era of civilization, 2,500 years; and (4) the era of modern engineering, 200 years.

Thus it required about 190,000 years for the human race to learn a few simple principles of mechanics and provide itself with rude tools and crude weapons. The accumulated knowledge appears to have included:

1. The simple properties of a few materials. Use was made of wood, stone, earth, pitch, and metals that are found in the natural state, such as copper.
2. The principles of the inclined plane, the wedge, the block and tackle, the beam and the column.
3. Methods of dressing leather, spinning crude fiber threads, weaving baskets, making pottery.
4. Development of water transportation by boats and canoes propelled by paddles or oars and finally by sails.

During the next 7,500 years the individual tribes of savagism became welded into nations and were organized and governed despotically. Great construction projects were prosecuted through the organized use of man power. Some gigantic ruins remain as mute testimony to the exploitation of the labor of human beings during this era. This period witnessed: (1) the construction of the pyramids, temples, and palaces of Egypt and Mexico; the irrigation canals of Chaldea; the great wall and the grand canal of China; 2,000 miles of surfaced road in Peru; the Mayan roads and pyramids of Yucatan; and the magnificent stone work of Tiahuanaca in Bolivia: (2) the mining of minerals; (3) the smelting of iron; and (4) the building of ships capable of ocean navigation.

Era of Civilization.~Generally civilization is said to date from about 500 B.C. It will be sufficient for our purposes to take at a gulp, as it were, the period from 500 B.C. to 1700 A.D. Its outstanding progress consisted of:

1. The development of the principles of hydraulics as applied to simple problems of drainage and water supply, and to canals, including locks. Power was obtained from crude water wheels.
2. The development of building into a fine art. The arch aided by the beam and column made possible those magnificent structures that are so great an inspiration to modern architects.
3. The use of iron, copper, and brass in art and industry.
4. The invention of the mariners' compass.
5. The building of complex military works, of offensive and defensive devices, stimulated by commercially developing gunpowder early in the fourteenth century.

While this list includes many items that were really milestones on the path of human progress, those that were ushered in with the invention of the steam engine, about the middle of the eighteenth century, far transcended in significance all that had gone before. It was they that laid the foundation for the substitution of heat power instead of labor of man and beast; that inaugurated the industrial expansion which characterizes the present generation. The inventions of a period which began only 170 years ago were destined not only to revolutionize the

industrial life of the world but also to provide the impetus for an enormous broadening of the scope of professional engineering. How strange that after perhaps a million years of slow and painful evolution from savagery, the human race, within the historically short span of less than two centuries, produced a few individuals whose inventions were destined to change completely the environment and living of all civilized peoples!

Starting with Steam.~These events began with the invention of the steam engine about 1750. Then followed the spinning jenny in 1767, the power loom in 1785, the cotton gin in 1793, the steamboat in 1807, and the locomotive in 1829. The next 100 years witnessed the perfection of such epoch-making inventions as the internal combustion engine, the steam turbine, the turbine water wheel, the electrical generator, the sewing machine, the metal plow, the harvester, the threshing machine, the electric light, the telephone, the telegraph, the radio, and the automobile. This imposing, although incomplete, list of inventions forms the background of the tremendous industrial expansion of the past one hundred years, a period which has culminated in the almost unbelievable engineering accomplishments of this century, which is still young, and the beginning of an era which appears destined to be known in history as "the machine age."

It is to be noted that the practice of the art of engineering is of great antiquity. Explorations of anthropologists have indicated that from the very earliest times certain individuals could use in a limited degree the forces and materials of nature and organize human effort in the construction of extensive projects—and that is engineering.

Engineering, as we know it today, emerged early in the eighteenth century, although no specific date can be given. Apparently one John Smeaton in 1761 formally assumed the title of (professional) engineer. The British Institution of Civil Engineers was the first of the great professional societies to organize, but that was not until 1818, or half a century after Smeaton.

What Engineering Involves.~The term "professional" engineer is in common use to differentiate the practitioners of technical engineering from the skilled operators of prime movers. It is also attaining a legal status and in some states may be used only by those who have secured a license. Is engineering in fact a profession? The term "profession" is defined as "a calling in which one professes to have acquired some special knowledge by way either of instructing, guiding, or advising others or of serving them."

Engineering requires training of a highly specialized character, followed by years of experience, to qualify a man for taking responsible charge of work. Therefore, the professional engineer does have "special knowledge." The major part of his work consists in guiding others in building structures or fabricating and distributing industrial products. Frequently he works in a peculiarly confidential relation to his client or employer. He is taught to use his special knowledge to secure the best possible solution to an engineering problem, and if he is endowed with the true professional spirit he will exhaust every resource at his command to secure the most efficient solution even though the employer has no possible means of checking the work as it progresses. So engineering truly is a profession, but it is doubtful if there is general public recognition of the really professional character of engineering service.

Engineering therefore has splendid traditions and a long history of brilliant accomplishment. However, it is to be recognized that the younger members of the profession must spend some years in work that is almost sub-professional in order to gain the experience required for truly professional employment. Some men, unfortunately, seem unable to rise above the marginal jobs on the fringe of engineering.

Engineering and craftsmanship must have developed together in the early years, but engineering gradually achieved an independent status as its practitioners learned more about the laws of the universe and the behavior of materials. Craftsmen organized into guilds and later into trade unions. The professional engineers eventually associated themselves together for the discussion of professional problems and the opportunity of stimulating fellowship. Beginning with the organization of the British Institution of Civil Engineers in 1818, one after another of the groups of engineers have organized national professional societies. The first in the United States was the American Society of Civil Engineers, established in 1852. From the beginning these societies have been active in developing and expanding the scope and reliability of engineering practice, and in fostering high professional standards.

The Professional Society Today.~Approximately ten years ago the Society began taking increasingly active steps looking toward the betterment of the economic status of the employed engineers, including those in the lower salary brackets. The setting up of the Society's Committee on Professional Objectives is the latest illustration of this trend. While the professional societies are not of the nature of bargaining agencies, and cannot function as such, they can wield a powerful influence on conditions of employment. But primarily they are professional societies concerned with the professional development of the membership.

In addition they are powerful, fundamental factors in behalf of the young engineer. They aid him to make steady professional improvement. Thereby they increase his earning power by the most reliable and permanent method—by making his services increasingly valuable.

The Society has done its share in developing sound engineering practice and in placing before its members the running story of engineering achievement. Its goal is to aid its members in the utilization of forces, materials, power, and human resources for the benefit of mankind. Many illustrious engineers have contributed time and effort to place engineering on a sound theoretical basis and to imbue the profession with the highest ideals of integrity and service. Their conception of the true professional spirit is woven into the fabric of traditions and philosophy of this great engineering society.

Momentous problems of material and human engineering continue to press for solution despite the tremendous progress of the machine age. The opportunities for service and accomplishment are unlimited for those who have the persistence to gain the necessary experience.

HENRY E. RIGGS
President

GEORGE T. SEABURY
Secretary

SYDNEY WILMOT
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DON JOHNSTONE
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CIVIL ENGINEERING

NOVEMBER 1938

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NUMBER 11

Rochester Meeting of the Board of Direction

Steps Taken to Strengthen the Technical Work of the Society

THE quarterly meeting of the Board of Direction held at Rochester, N.Y., on Monday and Tuesday, October 10 and 11, was outwardly uneventful, and internally it involved rather less debate than usual. Nevertheless, it resulted in some steps which promise to be of far-reaching importance to the Society.

The dispatch with which the Board handled the impressive agenda prepared for this meeting reflects the careful and conscientious work of the various committees which had under consideration those matters which were to come before the Board. These committees had been collecting facts and viewpoints through correspondence and special meetings in the interval since the July meeting and had fully prepared their reports and recommendations. In some cases this involved final special committee meetings on Sunday, October 9, in addition to the meetings of such standing committees as the Executive, Membership, and Publications, which are usually Sunday gatherings.

It is not our intention to report in detail on all the actions of the Board at the Rochester Meeting, but rather to select from the record certain items which appear to be of special interest for more extended statement and comment.

THE NOMINATING COMMITTEE

The Constitution of the Society provides that, not later than October 15 of each year, the Directors and the two last living Past-Presidents of the Society shall meet as a Nominating Committee and nominate an "Official Nominee for President." The Nominating Committee thus consists of the elected representatives of the Society from (at present) 16 states of the Union, and includes all the Board members except the President and the four Vice-Presidents. No member of this committee is eligible for nomination until at least two years after the expiration of his term of office.

The Nominating Committee usually meets, organizes, and elects its chairman and secretary following the Annual Meeting of the new Board in January. Nominations are seldom made, however, until at or after the summer meeting in July.

Needless to say, many factors determine the selection made by this committee. To reflect the truly national scope of the Society, it is important that over a period of years the successive nominees for its highest position should be drawn from various sections of the country. Another consideration is that a President must be able to give the necessary time and attention to representing the Society not only among its membership but in contacts with other groups—for this is an important part of his work. Finally, it is desirable that our chief executive should be thoroughly familiar, through previous service in Society affairs, with the problems of the Society, and that he should have demonstrated his competence, his fairness, and his patience and impartiality as a presiding officer.

Many other plans have been considered at various times for the nominating procedure and provision is made in the Constitution for "nomination by declaration." Any twenty-five Corporate Members in good standing can, for example, make a nomination by declaration. It is to be doubted, however, if a fairer, more widely representative method of nomination can be devised than that now followed by the Society.

In the September issue of "Civil Engineering" the Committee on Publications sponsored the first of a proposed series of brief articles which will bring more clearly to the attention of the membership the high lights of the quarterly meetings of the Society's governing body—the Board of Direction. In the present issue some of the more important problems discussed at the recent meeting at Rochester are reviewed.

TECHNICAL PROCEDURE

The Constitution of the Society states that one of the objects of the Society shall be the advancement of the science of engineering, and the problem of fostering the growth of technical knowledge has always constituted a basic, perhaps a principal Society objective. In fact, it seems clear that our Society has prospered and grown primarily because it has made, through the voluntary efforts and cooperation of its members, a real and important contribution to the technical development of the engineering art. Our technical problem is thus not simply one of maintaining a few committees, but rather a problem of organizing a membership of over 15,000 men for more effective advancement of technical knowledge.

Clearly the Board cannot undertake to give immediate direction to this problem in all its details. In fact, full realization of the Society's aims in this direction can be secured only through a comprehensive organization of the entire membership to cover the various technical fields of the profession. Accordingly, these fields of interest have been provided for in twelve Technical Divisions, in one or more of which every member of the Society can find an opportunity to contribute to "the advancement of the science of engineering."

While the Board must exercise final authority, the By-Laws delegate to a Technical Procedure Committee the duty of "effecting coordination of all the technical activities of the Society" and making "recommendations to the Board in regard to technical activities whenever such action appears to be advisable." The Technical Procedure Committee thus heads up the technical work of the Society. It consists primarily of the chairmen of the twelve Technical Divisions. Together with the Divisions themselves, it constitutes the machinery which has been provided to work out a major and fundamental objective of the Society.

Apparently in the past the Technical Procedure Committee has not completely realized the full scope of its activities and authority. Usually meeting but once a year, under difficulties as to available time, lacking the guidance of standing committees, frequently changing in membership, the Technical Procedure Committee has not been best organized to fully accomplish its intended purpose. That this committee and the Technical Divisions have done such outstanding work for the Society has been due more to the devoted efforts of individual members than to the scope and character of its organization. All the committee's work has been voluntary and many of its members have given generously of their time and funds in promoting it.

These shortcomings in organization were discussed by the Committee on Technical Procedure at a meeting held last April in Jacksonville. This, in turn, led to correspondence between Director Proctor and President Riggs. As a result of this study, proposals for strengthening its organization were made to the Executive Committee of the Board, were unanimously approved, and have been brought before the Board for final action. It is hoped that these proposals, through amendment of the By-Laws, will permit a more effective organization of this important committee. At the Rochester Meeting the committee was itself asked to consider these proposals and they were unanimously recommended to the Board for adoption in January.

The new plan will give more continuity of service to the membership of the Technical Procedure Committee by providing that Division chairmen serve for three years. It also provides for an executive committee of five to be elected by the committee itself. Finally, it authorizes the committee to elect its own chairman to serve for three years. The duties of chairman have previously devolved on the President of the Society, who serves but one year, has many other duties to perform, and has seldom been familiar with the problems of the committee.

A year or more ago a suggestion was made by Director Finch as to a possible reorganization of the Technical Divisions with the object both of more completely covering the various technical fields and of securing fuller coordination of the often overlapping activities of the various Divisions. Under the chairmanship of Prof. A. H. Fuller, a special committee of the Technical Procedure Committee has been considering this problem. This committee reported at Rochester and its proposals as adopted were designed to supplement the proposed reorganization plan. In particular, they delegate authority to the new Executive Committee to receive and critically review the annual reports of the various Divisions. In the past these reports have simply been printed in the minutes of the Technical Procedure Committee meetings. The Executive Committee can thus exercise a constructive and coordinating influence on Division work, encouraging activity where, as sometimes happens, progress has been slow, and also suggesting possible new lines of work or problems that may be jointly considered by two or more Divisions. In order to further such cooperation, the Divisions of Surveying and Mapping, of Construction, and of Economics, were recognized as representing functional activities of interest to all the other Technical Divisions, and provision was made for what in effect will be corresponding members in these Divisions. One such member will be appointed to each of these three Divisions by each of the other Technical Divisions to act as liaison officer and contact man on matters of common interest.

Finally, it was recognized that one of the basic problems faced by each of the Technical Divisions is that of enlisting the support of those members of the Society who can and will take part in the work of that Division. With the annual mailing of address cards, therefore, an inquiry will go out to the membership of the Society in reference to Division affiliation, and it is hoped by this means to secure an up-to-date list which will reflect Division interests and the willingness of members to give of their time and effort to a fundamental Society activity.

EXPERT SERVICES AND ENGINEERS' SALARIES

Among the other items discussed at Rochester was the matter of expert services such, for example, as those that are frequently rendered to various public agencies by consulting engineers. There has been a tendency in recent years toward limiting those engineering services which can be called upon by officials of established public agencies, thus depriving the public of the opportunity to secure the special abilities of recognized consulting experts and also, of course, seriously curtailing the field of activity of the consulting engineer. Upon the recommendation of the Committee on Fees (a standing committee of the Board), a resolution on this matter was passed which is printed elsewhere in this issue.

The Board has also long had under consideration a study of the salaries of engineers. It was clearly recognized that it would be impossible to suggest a single classification of engineering positions, with appropriate salaries which would be applicable to conditions all over the United States. Local conditions and standards obviously affect salary scales and any general list would inevitably lead to injustices in certain sections of the country. The Committee on Salaries has been working on this problem with the assistance of experts in this field and reported at Rochester that a proposed classification and salary scale for the lower grades of professional service—presumably with modifying local differentials—would be presented for adoption in January.

As its concluding action at Rochester, the Board adopted a pension plan which will fund, through the joint contributions of the Society and the Society's staff, a long-established obligation of the Society to staff members who give many years of faithful service to our membership.

"I hold every man a debtor to his profession; from the which as men of course do seek to receive countenance and profit, so ought they of duty to endeavour themselves by way of amends to be a help and ornament thereunto."—Francis Bacon ("Maxims of Law," Preface)

Background of the Thousand Islands Bridge

From a Paper on the Structural Division Program at the Society's 1938 Fall Meeting

By William T. Field

Member American Society of Civil Engineers
The William T. Field Engineers, Inc., Watertown, N.Y.

With the construction of railroads on both sides of the St. Lawrence River, the first attempts to span the river with a bridge in the Thousand Islands section were made. Probably the earliest structure contemplated was a railway bridge at Morrisburg, Ontario, for which a charter was granted in 1882, but the bridge was never built. In 1899 the New York Central erected its present railway bridge at Cornwall, Ont., and in 1934 this bridge was planked to accommodate vehicular traffic as well as trains.

In 1895 construction was started on a railway bridge between Brockville, Ont., and Morristown, N.Y., by way of the Three Sister Islands, to connect the Brockville, Westport, and Sault Saint Marie Railway with a branch of the New York Central; however, financial difficulties developed and construction ceased. Two piers are still standing.

About 1915 another project was contemplated for the construction of a high-level bridge across Brockville Narrows using Smith and Refugee islands. This project was revived about 1929 by a company which obtained a charter at Ottawa and one at Washington, D.C., but failed to secure legislation at Albany. Again, in 1926 and 1927, an attempt was made to build a private toll bridge from Collins Landing, N.Y., to Ivy Lea, Ontario, through the Thousand Islands, but although legislation was secured at Washington the bill in Albany was twice vetoed by the governor on the grounds that it was against public policy to construct a private toll bridge connecting public highways.

During its 1930 session, the New York State Legislature created the St. Lawrence River Bridge Commission to investigate possible sites for a bridge across the St. Lawrence and to report thereon. This report, covering six possible sites, was made to the 1931 session, but no action was taken on any of the recommendations.

In 1932 a group of local citizens in Watertown, N.Y., conceived the idea of building the bridge from Collins Landing to Ivy Lea as a work relief project; and a mass meeting held in June of that year resulted in the appointment of a General Citizens Committee of Jefferson County to further the construction. This committee, of which the writer was chairman, immediately began to investigate the project by securing all available data and making actual field surveys on both sides of the international line. To assist it in its work, the committee secured the cooperation of Robinson and Steinman, consulting engineers of New York, N.Y. A Canadian Bridge Committee that had been in existence since 1927 cooperated with the Jefferson County committee in supporting the project.

At the August 1932 meeting of the Jefferson County Board of Supervisors, a Bridge Committee was appointed to further the project and to protect the interests of Jefferson County, and an application to the Reconstruction Finance Corporation (RFC) was authorized and made.

In January 1933, Governor Lehman appointed the Emergency Public Works Commission of the State of New York, with the Honorable Robert Moses of New York City as chairman. The Jefferson County Board of Supervisors authorized its Bridge Committee to proceed in cooperation with this state commission to secure federal financing and to initiate necessary legislation.

Thousand Islands Bridge Authority Created

During its 1933 session, the New York Legislature passed a bill creating the Thousand Islands Bridge Authority, a public benefit corporation, and authorizing this Authority to build and operate the bridges and highways on the United States side of the international line in cooperation with Canadian interests which would build and operate similar structures on the Canadian side. At the same time a federal bill was passed extending the franchise for such a bridge, which had been secured two years previously by the New York Development Association to protect the interests of northern New York. Also at this time, the Canadian interests secured legislation in the Province of Ontario, creating the Thousand Islands Bridge Company of Ontario but not covering the international aspects.

During 1933 the PWA was set up, and the application for federal aid pending before the RFC was automatically transferred to it. The following year, legislation was secured in the Canadian Parliament by the Canadian Bridge Committee, creating the Thousand Islands Bridge Company of Canada and authorizing it to construct and operate the bridges and roads in Canada in cooperation with the public Authority and interests in New York State.

In 1935, after failure to secure federal aid from either the RFC or the PWA, the Thousand Islands Bridge Authority investigated the possibility of private financing. Private interests offered to underwrite the bonds of the Authority on condition that the American and Canadian ends of the project be consolidated under the Thousand Islands Bridge Authority of the State of New York. This necessitated additional legislation, which was passed by the state in 1936 and by the Canadian Parliament in the same year. It also was necessary to secure another year's extension of the federal franchise at Washington. Previous extensions had been secured in 1934 and 1935, the franchise having been transferred to the Thousand Islands Bridge Authority in 1934.

During 1936 exhaustive traffic surveys and investigations were made to comply with the requirements of the investment bankers. During the 1937 legislative session, the State of New York authorized construction of the connecting highways on the American side of the boundary and the Province of Ontario authorized similar construction on the other side. Bids were called for the construction of the bridges on March 10, 1937, and the ground-breaking ceremonies took place April 30, the last day that construction could begin under the terms of the federal franchise. Construction was completed in $15^1/_2$ months, and the official opening and dedication took place on August 18, 1938.

Construction of the Thousand Islands Bridge

By D. B. Steinman

Member American Society of Civil Engineers
Robinson and Steinman, Consulting Engineers, New York, N.Y.

Five river crossings of four distinct types, and a number of connecting viaducts, comprise the project known singly as the Thousand Islands Bridge—the newest physical connection between New York State and the Province of Ontario and the only one in the 300-mile stretch of lake and river between Niagara River on the west and Cornwall on the east. General features of the project design were described by Dr. Steinman in the June issue, and here he continues with an account of the construction methods. Despite the variety of structures, the severe weather conditions during the winter, and the necessity for handling a large part of the material from boats, the work was completed in $15^1/_2$ months —$2^1/_2$ months ahead of schedule. The present article is abstracted from a paper on the Structural Division program at the Society's 1938 Fall Meeting.

Construction of the Thousand Islands Bridge presented a number of interesting aspects. First, of course, was the variety of structures, each of which required its own erection methods. The international aspect of the project had also to be considered. This involved the engagement of contractors and labor from both countries, with respective differences in construction methods and working conditions. Again, the location of some of the structures made it necessary to transport material and equipment to the site by water; and property restrictions and the rocky character of the shore prevented the use of the islands or Canadian mainland for material handling and storage. Finally, much of the steel was erected during the winter, when the river was full of ice and movement of material by water was impossible.

The American Crossing comprised a suspension bridge of 800-ft main span and the approach viaducts. A feature of the construction was the pumping of the concrete for the main foundations and the high approach piers. No concreting towers were used; instead, a pump delivered the concrete through pipe lines running up the high piers. Other concrete on this contract was placed by means of a crane on the ground.

Fabricated steel was received by rail at Clayton, N.Y., about seven miles from the bridge site, and was yarded there at a point accessible by rail, highway, and river. The bulk of it was transferred by barge to the site, but the mainland viaduct steel, half of the cable strands, and part of the suspended structure were hauled by automobile truck.

The towers were started by a caterpillar crane, but were mostly erected by 20-ton guy derricks. To support the derrick, two of the 60-ft girders belonging to the permanent approach viaduct were pressed into temporary service. These were placed transversely to the bridge axis and rested on temporary brackets that were bolted to the tower legs. Two of the four derrick guys were connected to the ends of one of these girders, and the other two to the ends of 12-in. wide-flange beams, 75 ft long, which were placed longitudinally and braced by wire rope ties from their ends down to the bottom strut of the tower. This entire derrick assembly was jumped successively to higher positions.

Winter was near when the towers were completed (November 1937) and it was doubtful whether good progress could be made on the erection of the high, exposed suspension cables in the severe cold, especially since the use of catwalks was not contemplated. It was therefore decided to proceed instead with the erection of the approach viaducts, since it was believed that this could best be done on frozen ground.

The viaduct on Wells Island was tackled first so that the caterpillar crane could be brought back to the mainland before the river became blocked by ice. A 100-ft boom was necessary in the 30-ton crane to set the highest girders. The mainland viaduct followed and, as the 100-ft boom proved too short, a steel gin pole 120 ft long was used on some of the highest parts.

By this time (March 1938) the winter was over and the erection of the cable strands followed. These 74 strands, $1^1/_4$ in. in diameter and 2,123 ft long, had been prestressed, measured, marked, and socketed at the wire mill. Delivered at the site on individual reels, the strands were drawn over the towers and across the river by hauling-cables connected to a hoisting engine, one strand being drawn from the island to the mainland at the same time that another moved in the opposite direction. This operation was conducted without any interference with navigation. Critical points, such as the center of saddle castings, had been marked with paint on the strands at the mill, but the erector was not guided wholly by these markings. Observations were made on the sag, generally at night, to assure correct adjustment.

American Suspension Span and Approach Viaducts During Construction

The total calculated stretch in the cable between anchorages, from free catenary length to full dead-load condition, was 3.594 ft. The corresponding calculated height of the free cable in the 800-ft main span above full

The American Crossing
Mainland at the Left, Wells Island at the Right

dead-load position was 9.141 ft. For computed balancing of the five catenaries during cable stringing, it was necessary to move the main tower saddles back (away from the river) 1.507 ft, and the cable bent saddles 1.117 ft. For this purpose, the main saddle castings were temporarily offset 1.507 ft shoreward on the towers, as this method was preferred to deflecting the tower itself into the required position; and the cable bents, of rocker design, were simply tilted back 1.117 ft. After completion of the cables and before erection of the suspended steelwork, when calculations showed the operation to be safe, the main tower saddles were jacked forward (toward the river) to their final centered position on the towers; and the cable bents automatically tilted forward, during this operation and the subsequent dead-load erection, to their normal positions under full dead load.

Erection of the Continuous Truss Bridge

The stiffening girders, floor system, and locked I-beam assembly for the concrete floor were erected by overhead trolley and cableway. The American channel of the St. Lawrence River is the principal navigation lane, so that it was impossible to anchor the steel supply barges in midstream. The steel units were therefore hoisted from barges alongside the towers and run out on lines from the cables to the point of erection.

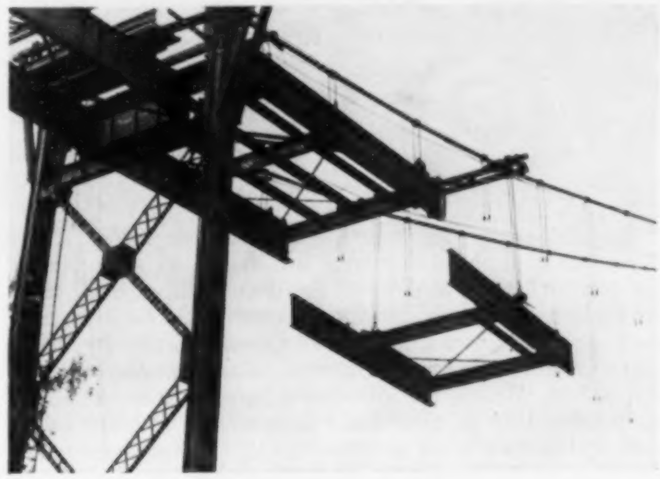
For the concrete roadways for the American crossing, a paving mixer was set up on the mainland end of the approach, discharging directly into 2-yd dump trucks. These trucks ran over plank roadways set on the forms, and were turned, to permit rear dumping, by a hand-operated turntable kept near the point of placement. Turnouts every 1,000 ft permitted two-way operation of the trucks. Calculated loading requirements on the suspended spans governed the sequence of concreting in sections. Though the slab was not poured continuously from end to end, the sections were always worked toward the mixer. On the approach viaducts, the roadway slab was finished with a mechanical screed and tamper, fabricated especially for this job, and operating on regular road forms.

For sidewalk forms on the suspended structure, ribbed metal lath was used instead of the usual tight wood panels. The lath, with the ribs running transversely, was grouted to the sidewalk support angles prior to the concrete placement, and small concrete blocks were set on it to support the slab reinforcement. Surprisingly little concrete was lost through the mesh of the lath.

INTERNATIONAL RIFT BRIDGE AND CANADIAN CROSSING

The only international span is the 90-ft rigid-frame bridge over the International Rift. Its location was inaccessible to vehicles, and equipment and materials had to be brought in on small barges through the narrow, winding channel of the rift. The span was built on falsework supported on closely spaced piles.

The Canadian crossing comprised three bridges and the connecting and approach viaducts. The main tower



Erecting the Floor System of the American Suspension Bridge, near the Cable Bent

piers of the Canadian suspension bridge were poured from barges. The south main pier was sealed in a cofferdam by a tremie pour, while the north pier, located on a shore ledge, was most easily reached from a concreting tower on a barge. The pedestal piers on Georgina and Constance islands were poured from a runway by means of wheel carts, and the arch abutments were poured from concreting towers.

Erection conditions on the Canadian crossing differed from those on the New York side in several features: (1) The restriction against obstruction of the channels for navigation did not prevail, and the steel was therefore hoisted directly into place from barges; (2) electric power was not available, and therefore all construction equipment was powered by steam, gasoline, or compressed air; (3) natural conditions and property restrictions prevented storage of material on land.

The continuous truss bridge consisted of two 300-ft spans. The first span was erected on falsework, and the second was then cantilevered four panels beyond the center pier and completed on falsework from that point to the far end. This procedure was planned so that no reinforcement of the trusses for erection stresses was necessary. The guy derrick on Hill Island erected the timber bents and steel floor system as far as it could reach, and then a whirlie crane, first mounted on a scow and then set up on the deck, completed the erection.

After erection, the two continuous spans were completely riveted except for the center sections of the top chord, which were left bolted. The elevations of the end and center bearings were checked to make sure that the bridge was level over the three supports; then the reactions were checked by jacking one end vertically the calculated distance to give zero stress in the center section of the top chord, and then examining the bolted connections; under this condition the bolts were found

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The Canadian Crossing
Mainland at the Left,
Hill Island at the Right

URING THE FLOOR ON THE AMERICAN SUSPENDED SPAN

to be free, the holes fair, and the finished surfaces just in contact—all as calculated. These connections were therefore riveted at zero stress and the bridge end was then lowered to its original position.

The steel arch bridge has a span of 348 ft. Each rib was fabricated in eight sections, weighing 10 to 13 tons each. All holes were punched $^{11}/_{16}$ and reamed to $^{13}/_{16}$. Flange angles and cover plates were bent cold. The ends of each section were finished in a rotary planer for precise length and bevel. All steel tapes used were checked with a certified tape and corrected for temperature, and care was taken at all times to have steel and tapes at the same temperature. Each section was increased in length an amount equal to the computed shortening due to dead-load compression. After fabrication, the four sections in each half rib were assembled on skids in the shop, the offsets from the horizontal and from chords checked, and field connections reamed. The center splice was reamed with part of each half rib in place.

Ribs and bracing were erected by cantilevering out from the abutments, using suspender ropes temporarily as tie-backs. Four suspender ropes were used in each tie-back, and their anchorages were of steel concreted in the rock.

The steel for both ribs and rib bracing, some 200 tons, was transported by river to the site and erected direct from the scow, without rehandling. For this work a whirlie crane with 96-ft boom, mounted on a scow, was used. The crane scow was lashed between two others, including the one carrying the steel, for greater stability.

Final closure of the ribs was made by lowering the bents supporting the tie-backs, two hydraulic jacks being used under each bent. After the closure, the whirlie crane was placed back on the viaduct deck and used for erecting the bents and floor steel.

ERECTING THE CANADIAN SUSPENSION BRIDGE

The towers of the Canadian suspension bridge were erected by vertical creeper travelers, after the bottom sections had been erected by cranes. These travelers were left on top of the towers to be used later in cable erection and for handling deck material and the north approach steel.

The 74 strands for the main cables were made in double lengths, so that two strands and one test piece could be cut from each length. These double lengths, with a permanent socket on each end, were delivered to the prestressing plant and prestressed and marked before being cut into individual lengths. Each strand was prestressed to a load of 110,000 lb, which is approximately one-half of the ultimate strength. Then, at a load of 39,000 lb (the calculated dead-load stress), the strands were marked for length and for saddle positions. Two guide strands were also marked for location of cable bands. The strands were then cut, and the remaining sockets put on. Six of the test pieces were picked at random by the engineers' inspector and tested for modulus (25,000,000), yield point (148,000), and ultimate strength (215,000 lb per sq in.); and six other specimens, one equipped with a complete sleeve and socket assembly, were tested for ultimate strength. The results were highly uniform in all tests.

The cables were erected without the use of catwalks. Instead, track ropes were strung across the river to carry traveling cages, one for each span. These cages were light but of sufficient strength to carry men and material such as cable bands. The track ropes were adjustable at each tower so as to permit raising and lowering of the cages.

All reels of cable strand were mounted on a platform on the south anchorage. One strand at a time was pulled across the channel by a $^{5}/_{8}$-in. pulling line with swivel attachment, this pulling cable being returned to the south shore by means of a light return line. In being pulled across, the strand passed over wooden reels near the tops of the cable bents and main towers. It was then picked up and placed in the saddles at the cable bents by falls hanging from gallows frames, and at the towers by the creeper travelers. The strands were kept under tension at all times so there would be no tendency to kink or buckle. This work was done in severe winter weather, but in spite of the cold and strong winds there were no mishaps.

A 120-FT GIN POLE WAS USED TO ERECT THE CABLE BENT AND SOME OF THE HIGHEST GIRDERS OF THE AMERICAN APPROACH VIADUCT

The first strand erected for each cable was set in the saddles at the premeasured guide marks indicating the calculated location. Instrumental observations were then made for sag and out-of-plumb measurements of towers and cable bents, together with temperature readings at each end of the bridge. On the basis of these observations and the corresponding catenary calculations, the stand was adjusted. The three other strands in the bottom layer of the cable were next erected and adjusted to the same sags as the first. The remaining strands were then erected, each layer being adjusted to the one below before erecting the next layer of strands. The observations and adjustments were made in the hours about daybreak when the wind and temperature conditions were as stable as possible. Such adjustments as were necessary were very small. As soon as each layer was adjusted, temporary clamps were placed on the strands at each side of each tower saddle to prevent any tendency of the strands to slip in the saddles. Upon completion of the cable stringing, the cable bands and suspenders were put in place by men working in the traveling cages.

Cable wrapping was the final operation. To insure tightness of the wrapping wire, this work was not started until nearly all the dead load was on the bridge. An air-operated, three-spool wrapping machine, invented and designed by Holton D. Robinson, M. Am. Soc. C.E., was used. The wrapping wire was delivered to the site in coils and there reeled on the spools. The men handling the wrapping machine worked from a platform suspended from rollers running on the cables.

In the Canadian channel of the St. Lawrence River, it was permissible to anchor the steel supply barges in midstream. The stiffening girders and floor steel for the center span and that part of the south side span over

Detail of Arch Rib Erection, Showing Tie-Backs
For Final Closure, Bents Supporting Tie-Backs Were Jacked Down

Cable Wrapping on the Canadian Span
A Special, Air-Operated, Three-Spool Machine Was Used

the water were erected by a traveling frame carried on the main cables, the steel being lifted to position directly from the scows below. The north arm and the south panel of the south arm were erected by cranes. The suspended panels were erected in such order as to keep the tower-top deflections at all times within precalculated permissible limits.

The south approach viaduct on Hill Island and the girder spans over Constance Island and Georgina Island were erected from the bridge deck with a whirlie crane. For the viaduct over Constance Island, 516 ft long, a guy derrick on shore was used to handle the material from the scow to the erecting crane. For the north approach viaduct on the Canadian mainland, the steel was unloaded from scows and distributed at the site with the traveler on the north main tower of the suspension bridge, the crane on falsework back of that tower, and a guy derrick on the anchor pier. The steel was then easily placed with the derrick and crane.

Tower Erection, Canadian Suspension Span

For pouring the concrete deck on the Canadian spans and viaducts, the plant was on a barge wherever possible, the concrete being hoisted up wooden towers and then chuted into three-wheeled motor buggies holding half a cubic yard. For pouring the suspension bridge deck, one plant was set up on shore near each end of the bridge, and concrete was delivered from both ends.

WIND BRACING OF SUSPENSION BRIDGES

Although the stiffening girders of the two suspension bridges (800-ft and 750-ft main spans, respectively) are only 6 ft deep, establishing a new low depth-ratio for modern suspension bridges, the rigidity of the structures under live load has proved completely satisfactory. Since their opening, the spans have been repeatedly service-tested under the most severe conditions of solid congested loading.

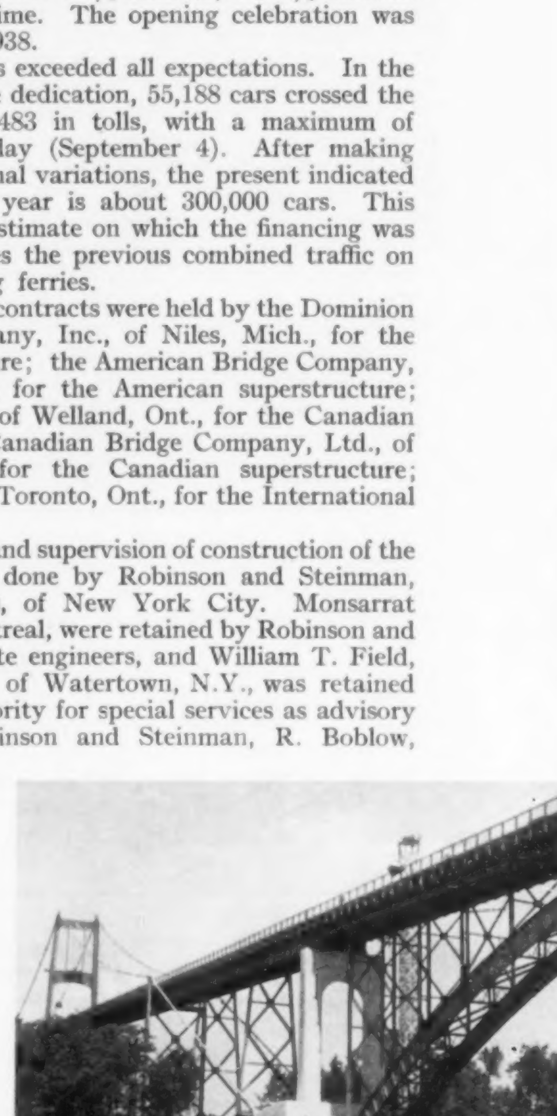
In order to secure increased vertical rigidity against wind loading and to prevent or check the setting up of harmonic oscillations under certain conditions of a quartering wind on the exposed high spans, two novel features of wind bracing were introduced. One consisted in the provision of diagonal struts between girder and cable at the center of the main span, thereby anchoring the span against longitudinal motion and preventing the initiation of vertical oscillation. The second innovation is the installation of diagonal rope stays, of $1^1/_4$-in. wire rope, running from the expansion ends of the stiffening girders to intermediate panel points of the cables near the quarter-points of the span, for more direct checking of vertical oscillations. The combination of these two novel wind-bracing features, although highly economical, has proved completely effective.

From the ground-breaking ceremonies on April 30, 1937, cooperation speeded the work to permit opening the bridges to traffic in $15^1/_2$ months, or $2^1/_2$ months ahead of contract time. The opening celebration was held on August 18, 1938.

Traffic to date has exceeded all expectations. In the first month after the dedication, 55,188 cars crossed the bridge, paying \$69,483 in tolls, with a maximum of 5,786 cars in one day (September 4). After making correction for seasonal variations, the present indicated traffic for the first year is about 300,000 cars. This is twice the traffic estimate on which the financing was based, and ten times the previous combined traffic on the three competing ferries.

The five principal contracts were held by the Dominion Construction Company, Inc., of Niles, Mich., for the American substructure; the American Bridge Company, of New York City, for the American superstructure; Cameron and Phin, of Welland, Ont., for the Canadian substructure; the Canadian Bridge Company, Ltd., of Walkerville, Ont., for the Canadian superstructure; and R. A. Blyth, of Toronto, Ont., for the International Rift span.

Planning, design, and supervision of construction of the entire project were done by Robinson and Steinman, consulting engineers, of New York City. Monsarrat and Pratley, of Montreal, were retained by Robinson and Steinman as associate engineers, and William T. Field, M. Am. Soc. C.E., of Watertown, N.Y., was retained by the Bridge Authority for special services as advisory engineer. For Robinson and Steinman, R. Boblow, Assoc. M. Am. Soc. C.E., was in charge of the resident engineer corps on construction, and J. London of the office force on design.



The Georgina Island Abutment of the Arch Span

Outlet Works and Power Plant, Sacandaga Reservoir

Operation of Sacandaga Reservoir

Multi-Purpose Project Provides Both Flood Control and Low-Flow Regulation for Hudson River

From a Paper on the Waterways Division Program at the 1938 Fall Meeting

By Edward H. Sargent, M. Am. Soc. C.E.
Chief Engineer, Hudson River Regulating District, Albany, N.Y.

Much has been written in the past few years on the impracticability of utilizing storage reservoirs for the combined purposes of flood control and low-flow regulation. It is the writer's belief, however, that where sufficient storage can be obtained multi-purpose operation of a reservoir is entirely practicable. A case in point is the Sacandaga Reservoir, in New York State, which in eight years of operation has successfully met the requirements of both flood control and low-flow regulation. This operating period, it is to be noted, has included several great floods—one of them the maximum of record—and several years of extraordinary drought.

The Sacandaga Reservoir was created by the New York Hudson River Regulating District by the construction of the Conklingville Dam on the Sacandaga River, about six miles above its confluence with the Hudson. The reservoir has an available capacity above the low-draft line of 760,000 acre-ft, which is equivalent to 13.7 in. of runoff on the 1,040 sq miles of controlled drainage area. (The average annual runoff from the same area is 27.6 in.) Although the Sacandaga River is not considered an exceptionally flashy stream, yet there is a large variation in its flow, the maximum flow being 64,400 cu ft per sec, and the minimum, 35 cu ft per sec.

The reservoir was constructed to regulate the flow of the Hudson and Sacandaga rivers "as required by the public welfare, including public health and safety," that is to say, to reduce floods and increase the low-water flow of the rivers in question. Prior to its construction, elaborate mass curves and studies were made from which the operating chart shown in Fig. 1 was developed. This chart shows the regulated flow to be maintained at Spier Falls (the so-called center of gravity of power on the Hudson River) as a function of the elevation of the reservoir at any given date. It was prepared with the idea of maintaining at Spier Falls a minimum regulated flow of 3,000 cu ft per sec and a maximum regulated flow of 6,000 cu ft per sec—which is the maximum capacity of all but one of the power plants on the stream—except when high discharges from the uncontrolled area cause the flow to exceed that amount. The duration curve (Fig. 2), which shows both the computed natural flow and the regulated flow at Spier Falls for the period July 1, 1931, to June 30, 1938, indicates how well this intended operation has been accomplished.

Specific Data on Individual Floods

That this high degree of regulation has been obtained without sacrificing the capacity of the Sacandaga Reservoir to reduce floods is shown by the fact that no water has passed over the spillway in the eight years of operation. Specific data on the effect of the reservoir on individual floods are even more convincing:

Date of Flood	Flow of Hudson River at Spier Falls, Cu Ft per Sec		Reduction Due to Reservoir Operation
	Actual	Unregulated (estimated)	
October 7, 1932	23,300	48,000	24,700
April 18, 1933	28,000	56,000	28,000
July 8, 1935	10,000	25,000	15,000
March 1936	39,500	92,000	52,500

But for the Sacandaga Reservoir, the 1936 flood (Fig. 3) would have been the greatest in the history of the Hudson River. At Albany, where the drainage area is 8,100 sq miles, it reached a crest of 17.70 ft on March 19, and the flow was estimated to be in the vicinity of 220,000 cu ft per sec. It is estimated that the Sacandaga Reservoir reduced the flood peak at Albany by approximately 50,000 cu ft per sec, which means that the flood height was probably lowered about 4 ft. (The maximum recorded flood at Albany, on March 28, 1913, reached a height of 21.45 ft and a discharge of 240,000 cu ft per sec.)

The Sacandaga Reservoir, which drains 1,040 sq miles, had a peak inflow on March 18, 1936, of 64,400 cu ft per sec—nearly 10,000 cu ft per sec greater than the estimated "thousand year flood." Although a flood of such great extent had not been anticipated, the deep snow cover had indicated that a large flood would doubtless occur, and accordingly the reservoir had been almost completely depleted in January and February and during the first part of March. Between March 13 and March 21 some 340,000 acre-ft were impounded, but at the end of that period the water surface elevation was still almost 17 ft below the spillway crest.

The great value of the Sacandaga Reservoir in increasing the low flow

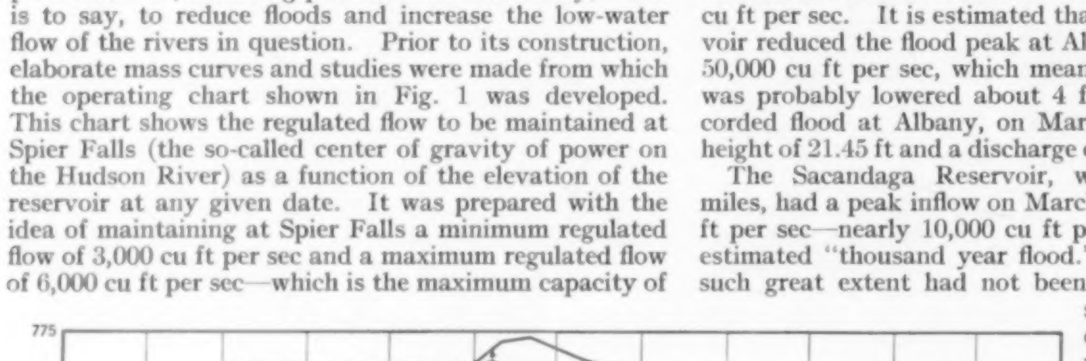


Fig. 1. Sacandaga Reservoir Operation Chart

This Chart Serves as a Guide Rather Than as a Rigid Schedule. During Long-Sustained Wet Periods More Water Is Released Than Here Indicated, in Order to Preserve Flood Control Capacity

of the Hudson River was thoroughly demonstrated a few months later. During August 1936, the reservoir releases constituted about 55 per cent of the flow of the Hudson River at Albany, and it is believed that without such release to dilute sewage and trade wastes, a condition most dangerous to health would have resulted. There were other concomitant benefits, both to navigation and in the prevention of unemployment. From data obtained from some of the beneficiaries, it is estimated that approximately 2,500 men would have been thrown out of employment at various mills along the river, which could not have remained in continuous operation without the assistance of the reservoir releases.

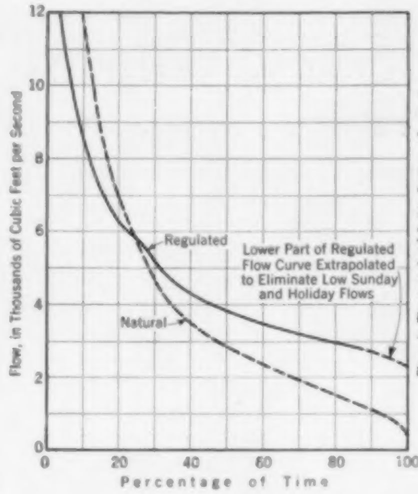


Fig. 2. Duration Curve of Daily Flows, 1931–1938 (Spier Falls)

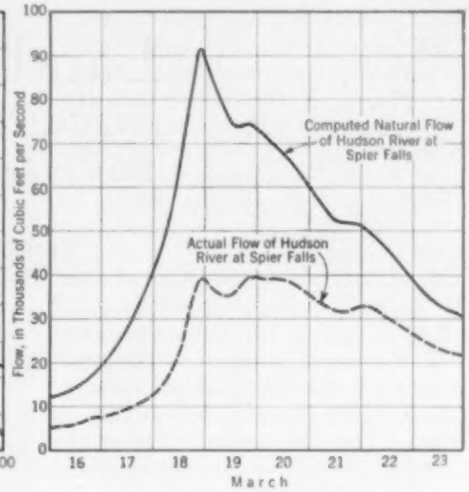


Fig. 3. Effect of Reservoir on Flood of March 1936 (Spier Falls)

INCIDENTAL POWER DEVELOPMENT AT DAM

Water released from the reservoir for river regulating purposes is utilized incidentally for power development in a plant at the dam, constructed and operated by the New York Power and Light Corporation under an agreement with the Board of Hudson River Regulating District. This plant operates under a head varying from 73 to 40 ft, and the installation consists of two 17,000-hp turbines directly connected to two 12,500-kva generators. When the plans for the Sacandaga Reservoir were first prepared it was believed, in view of the probable interruptions in release of water from the reservoir and the wide fluctuation in head, that a power plant at the dam might not be feasible. However, because the system into which the energy from this station is fed has many other plants, it was decided to build it. The company pays the Board for the use of the water, and it should be noted that the agreement with the company provides, among other things, that "Nothing in this contract shall be construed as in any way limiting the rights of the District to release water impounded by the dam at whatsoever rate and whatsoever time the District desires or as in any manner to interfere with the purpose for which the dam is built."

The plant is closed entirely during the regular reservoir filling period (from the middle of March until early in May) and during other extreme flood periods on the Hudson, when no water is released from the reservoir. However, because of the large transmission network of the utility system, this does not materially interfere with power operations. A total of 536,790,000 kwhr has been generated by the station in its eight years of operation.

I should like to add that there has been the finest cooperation between the officials of the power company, who formerly owned the dam site, and the engineering staff of the Board; and that the company has carried out to the last detail the instructions of the Board as to the use of water.

In the case of the Sacandaga Reservoir, the only allocation of storage solely for flood control is, generally speaking, the 3 ft of storage immediately below the spillway crest, which is reserved for that purpose in the spring. This comparatively small allocation was made because it appeared that all or nearly all of the control of floods could be obtained through normal operation of the reservoir for low-flow regulation. Eight years of experience seem to have justified this allocation. I do not wish to imply that in my opinion as complete flood control can always be obtained by a multi-service reservoir as by a reservoir or detention basin reserved solely for flood control purposes, as in the case of the detention basins of the Miami Conservancy District and the reservoirs of the Muskingum Conservancy District. However, in this connection it should be borne in mind that the Sacandaga Reservoir has an available capacity of 13.7 in. on its watershed, whereas most of the 14 Muskingum Conservancy District reservoirs have a capacity of but 7 in. on their respective watersheds.

Although the Sacandaga Reservoir has several times had a large effect in reducing floods on the Hudson River, only 5 per cent of its $12,000,000 cost was charged to flood control. The remaining 95 per cent was paid by the power companies whose plants benefit from the regulation. It is also pertinent to note that none of the cost of this reservoir was charged to navigation. However, its operation has benefited navigation in several ways. It makes possible an earlier opening of the Champlain Canal by lessening the spring floods, and limits the need for closing the canal during summer and fall floods. It has increased the minimum depths in the Hudson River at the port of Albany. And finally, it has made it possible to build the docks there at a lower elevation because of the lowered flood heights.

Doubtless there are available many storage reservoir sites which are not economical of development for either flood control, navigation, or power purposes alone, but which are feasible for the combined purposes. However, the common belief that these various purposes cannot be simultaneously and successfully accomplished has acted as a deterrent to the construction of such reservoirs. Of course, any generalization as to the type of storage to be created at a given site is very dangerous. It is my belief that if a multi-purpose reservoir is to be feasible, its available storage should be nearly twice that required for a project solely for flood control, and equivalent to at least 50 per cent of the mean annual runoff at the site.

In conclusion, I wish to stress that the results achieved in operating the Sacandaga Reservoir were made possible by the complete freedom granted by the Board of Hudson River Regulating District to its chief engineer so to operate the reservoir as in his judgment would best regulate the flow of the Sacandaga and Hudson rivers in the interest of the public welfare, including public health and safety. The operation of any multi-purpose reservoir requires absolute integrity on the part of the controlling board, and power to withstand any temptation to sacrifice flood storage for power purposes.

Land Surveying in Texas

Problems Involved in Following the Footsteps of the Original Surveyors

FROM AN ADDRESS PRESENTED BEFORE THE TEXAS SECTION

By W. A. ROUNDS

ENGINEER, CONTINENTAL OIL COMPANY, HOUSTON, TEX.

ATTEMPTING to restore the boundaries of a survey after an interval of many years is, at best, no simple task. But according to Mr. Rounds the natural difficulties are immeasurably increased in Texas. In part this is due to the peculiar and variable units of measurement, originating back in the days of Mexican occupation, and in part to misunderstanding of magnetic variation and similar human frailties. But mostly the troubles are those natural to the dimming and decaying processes of time, inherent in any resurveys, anywhere. These practical observations and advice will therefore find wide application elsewhere throughout the country.

WE Texans point with a great deal of pride to the many ways in which our state surpasses all others. But with reluctance we are forced to admit that no other state can equal Texas in the number of difficulties placed in the path of the land surveyor.

Surveying has been defined as measuring and marking off upon the ground the boundaries of tracts so that descriptions prepared from these measurements can be used to retrace the boundaries at some later date. This definition actually applies to the location and division of unsurveyed land, and while Texas is the largest state in the Union, only a very small percentage of its vast domain can be classified as unsurveyed. It therefore becomes the duty of the land surveyor to retrace and relocate the original surveys, and it is this problem that will be discussed here.

The courts have repeatedly specified that anyone retracing or relocating an original survey must follow in the footsteps of the original surveyor. According to Buckner's Digest (page 262) "What are boundaries is a question of law. Where boundaries are, is a question of fact." As the surveyor is a finder of facts, it follows that boundary questions must represent a detailed and careful rerunning of the original survey lines. Inasmuch as the larger part of the state was surveyed in some form during the nineteenth century, it is necessary to understand the practices and principles of those early surveyors before an accurate retracement can be attempted.

Texas has been under six flags, and four of these form an important chain in surveying problems—the sovereignties of Spain, Mexico, Texas as a republic, and Texas as a state. While Spain did not materially affect the boundaries of tracts granted, it is to Spain and to Spanish influence over Mexico that we must look for records and laws of the early colonization period.

The first area settled in Texas was in what is known as the coastal plain, under the leadership of Stephen F. Austin in the 1820's. These early leaders of colonization were titled "impresarios" and were given large grants by the Mexican government, to be divided and distributed among the various families according to the size and occupation of each.

The colonization laws specified how these grants were to be divided and gave rules and regulations for the land surveyors. Here began the now famous Texas *vara*, which in its present form is used nowhere else in the world. The colonization law of 1823 was substantiated by the law of 1832, which decreed for Coahuila and Texas as follows:

A CORNER TREE "X"—NOT ALL ARE SO CLEARLY MARKED

Measuring land—a square of land measuring one league, consisting of five thousand *varas* on each side, or, what is the same thing, a superficiency of twenty-five million square *varas*, shall be called a *sitio* and this shall be the unit for enumerating one, two, or more *sitios*, in the same manner, one million square *varas*, or one thousand *varas* on each side, shall constitute a *labor*, shall be the unit for reckoning one, two, or more *labors*. The *vara* for this measure shall consist of three geometric feet (*Early Laws of Texas*, Sayles, Vol. 1, p. 83).

Although it was agreed by the surveyors of Austin's Colonies to use 33.4 in. as a vara, $33^1/_3$ in. was accepted by others, and the vara was standardized in Texas by an act of the regular session of the Thirty-Sixth Legislature in 1919, when among other units of measure, the following was included; " . . . the Spanish vara shall be $33^1/_3$ in."

As the early settlers were desirous of obtaining water frontage, the senior surveys were constructed to secure maximum riparian rights. This resulted in a system of irregular surveys fronting the major streams and running back more or less perpendicularly for a sufficient distance to take in the required acreage. This of course left vacant areas on the inside, which were later divided by fill-in surveys, with a rather haphazard attempt to assure that all the land was included. Such procedures were bound to leave numerous vacancies and conflicts.

When Texas gained her independence from Mexico, her vast areas of vacant lands were her main source of revenue. Debts to soldiers, to companies, and other expenses were paid for in land. This condition did not cease when Texas entered the Union in 1845; for she was allowed to retain her public domains and to use them extensively in obtaining investments of outside capital, such as in railroads, for developing what was then a frontier.

FINDING A POINT OF BEGINNING

In resurveying an original grant, the first question, and undoubtedly the hardest, is to find a point of beginning—note that "a point of beginning" is specified and not "the beginning point," for "The beginning corner in the plat or certificate of survey is of no higher dignity or importance than any other corner of the survey" (*Texas Land Law*, by Edwin Hobby, page 171).

The beginning corner should be one that bears the greatest merit in the eyes of the surveyor. An original corner that can be proved to be such is the logical starting point. Fence corners, iron pipes, or other artificial objects, although identified as corners by local people, are not original cor-

ners and should not be used as such unless tied into the original notes by other surveyors or by conclusive circumstantial evidence.

Any deviation from such a rule may cause a surveyor no little embarrassment if he is called on to testify in court. His initial statement, "I began at such and such a corner of such and such a survey," is sure to be challenged at once, and unless he has information to substantiate his assertion, he may encounter considerable difficulty in getting beyond that one statement.

Once the beginning point is established, the actual retracement of the lines follows. Here again it is well to disregard, or at least accept as only corroborative, the existence of present roads and fences. It is a common practice to include a little more land each time a fence is reconstructed, and in time this changes a line's location enough to cause trouble. If two or more original corners can be found, well and good, for the footsteps of the original surveyor should fall between these two points. While streams that are called for in passing are not locative calls and cannot be given the weight of such calls, they do form a logical pattern upon which to construct a picture. The greater their number, the better is the chance of relocation.

An Original Bearing Tree, Marked with a Tree Scribe

The Mark, Faintly Discernible on the Original Photo, Has Been Slightly Retouched for This Reproduction

If the area is large, an aerial photograph is of great use, for the notes can be superimposed on it and the stream crossings readily worked out. In some instances, when stream meanders are shown, it is possible, by using aerial photographs, to determine the mean error or "overage" in the original surveyor's work before going into the field. Thus the area of search for original corners may be changed as much as several hundred feet. These photographs also afford an opportunity to study a large area as a whole—the relative position of control points ten to twenty miles apart—without actually running the connecting lines.

Survey Party Traveling Down a Texas Bayou

The Modern Surveyor Makes Quicker Progress Than the Old Timer—and with Less Effort

In following these original lines, the significance of marked trees must not be overlooked, as it was a universal practice, in timbered areas, to mark not only witness trees but line trees as well. They afford the best of evidence of the actual presence of the original surveyor. How they do so can be seen by studying the growth and life processes of a tree. The growth early in the season is formed when the tree must transport vast amounts of water and food; therefore the cells and tubes are large and thin walled. Later wood is composed of smaller cells with heavier walls. This difference in cell structure produces the visible annual rings. It is possible to tell much more than a tree's age by counting the rings—a poor growing season results in a narrow ring, a rich season in a wide one. This allows a surveyor to correlate his age determination with periods of wet and dry years.

As the cambium manufactures new wood, it increases in size, forcing the bark outward. The older bark, being dead, cannot stretch and expand. Consequently it cracks into plates, ridges, or scales. While this will not cause a surveyor's marks to fade out, it will cause them to spread, and those that were cut vertically are very difficult to find. The most common mark used for bearings is the letter "X," for here is one that is made across the grain at all points. Future growth will spread the "X" until it sometimes requires a practiced eye to find it, but as a general rule some trace of the cutting edge of the ax will show. In time such letters as "O," "P," "Q," and "C" will become just blazes, as the center of each letter will drop out.

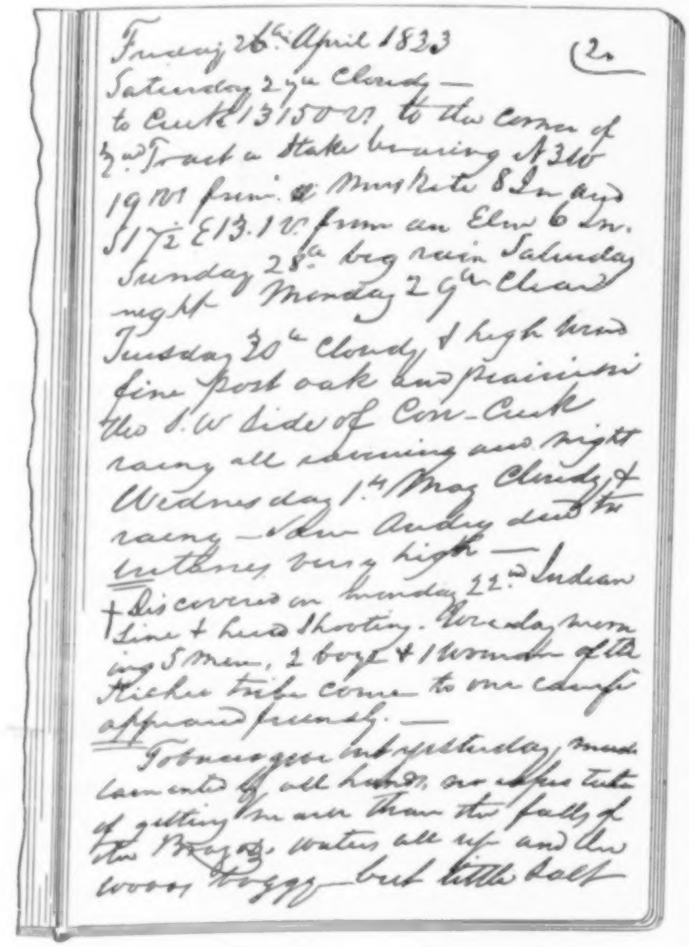
Identifying a Scribe-Marked Tree

In many early surveys, a scribe was used, cutting fine, clear letters into a smoothed blaze on a tree. These trees are extremely hard to find, for the blaze will heal over and, as far as outward appearances are concerned, the mark is gone. If the tree is cut and split on the plane of the original marking, however, the letters are extremely clear and legible. It is a wise rule, if an attempt is to be made to "block out" a scribe-marked tree, to do so with correct authority and with plenty of witnesses. In blocking out a tree for age determination, it is customary to remove an entire section containing the ax mark on the face. This is cut in the form of a wedge, with the base or bottom perpendicular to the trunk and the upper or angle face slanting through the rings to facilitate counting. The wedge so cut is then split into halves; the lip of the original cut is traced upward to the sloped edge; and from this point the rings are counted outward to give the age of the marking.

Most common is the line tree, which is generally marked with three hacks on the side nearest the line run or with fore and aft hacks on each side in the direction of the line. Many early surveyors had their own way of marking trees and it is often possible to pick out a certain surveyor's line by these peculiarities.

Thus, by the aid of line trees or other bearings, it may be possible to identify one of the original lines and to set off the present magnetic variation to fit the line as originally run. The possibilities of obtaining the mag-

netic variation used from any other sources are very slight. It sounds so simple to say, "Take an observation on polaris, and put down the north and south true meridian." Inasmuch as the original surveyor must have obtained his variation from the same meridian, it follows that the two lines thus run would be the same. There is only one flaw in this line of reasoning—the original surveyor generally made no attempt to determine a true


Friday 26th April 1833 (2
Saturday 27th Cloudy —
to Creek 1315 0 vs to the corner of
3rd Tract a Stake bearing N 3[illegible] W
19 vs from a Muskete 8 In and
S 17½ E 13.1 V. from an Elm 6 In.
Sunday 28th big rain Saturday
night Monday 29th Clear
Tuesday 30th Cloudy & high wind
fine post oak and prairie on
the S.W side of Cow-Creek
rainy all morning and night
Wednesday 1st May Cloudy &
rainy — Saw Andy [illegible]
waters very high —
Discovered on Monday 22nd Indian
line & heard shooting. Tuesday morn
ing 5 men, 2 boys & 1 woman of the
Kichie tribe come to our camp
appeared friendly. —
Tobacco give out yesterday much
lamented by all hands, no [illegible]
of getting [illegible] more than the falls of
the Brazos. waters all up and the
woods boggy — but little salt

A PAGE FROM A TEXAS SURVEYOR'S NOTEBOOK OF 1833

Two-Thirds of the Way Down, Francis Johnson, Working in What Is Now Milam County, Observed: "Discovered on Monday [April] 22nd [1833] Indian line and heard shooting. Tuesday morning 5 men, 2 boys and 1 woman of the Kichie tribe came to our camp appeared friendly.—Tobacco give out yesterday much lamented by all hands"

north, and in some instances did not know what magnetic variation meant. There are field notes in the General Land Office at Austin from one surveyor covering a period of some 18 years in which a 9-deg 30-min variation was used for every year and for every part of the state in which he worked. It is not unusual to find survey lines within a few miles of each other run by the same man, at different dates, having a difference in bearing of some 3 deg although the called bearing is identical. To have one line of a survey run on one variation and the next on another is, to say the least, disconcerting.

The correlation between course and distance is also vague, for there is a marked difference in how the vara was used in the field. In a personal letter to J. T. Robinson, Land Commissioner, A. M. Henderson stated:

> The English speaking colonists, who were accustomed to the English acres, caused the surveyors to calculate the Mexican tracts into acres, so they could understand how much land they had. We have no record or testimony as to how many square varas were supposed to be in one English acre before $33^1/_3$ in. was adopted as the length of the vara.

CHAINS OF VARIOUS LENGTHS

This resulted in the use of chains all called 10 varas, but which were in reality anywhere from 27 ft 9 in. to 29 ft in length. This, coupled with the dubious practice of throwing in one chain for good measure, led to considerable overage. A report by A. M. Henderson to the General Land Office in 1910 states that:

> Unless the surveyor uses the same length of chain that the original surveyor did, when retracing his lines, he will not reach the same points and will not follow his footsteps. In resurveying, I have often spent more time and done more work in first finding the length of the original surveyor's chain than in retracing his lines after I have found it. My custom is to remeasure as many of his lines as I can find, and from his calls for corners, or for crossing creeks and branches, get the average length that I find his lines to be between points that I can identify, and dividing it by 10 find out how many 10-vara chains are contained in them, and then calculate length of his chain.

Quoting also from Hobby's *Texas Land Law*, page 174:

> There are certain rules prescribed as to the relative importance of various factors that go to make up a set of field notes. It has frequently been said by the courts, that, in determining the relative importance of locative calls for different objects, preference should be ordinarily given, first to natural objects; second, artificial objects; third, course and distance.

This rule is further clarified (by R. H. Skelton, *Boundaries and Adjacent Properties*, page 92) by defining natural and artificial objects as follows:

> Objects, to be ranked as natural monuments, must have certain physical properties such as visibility, permanence and stability, and definite location independent of measurement. Artificial monuments are objects of lesser stability and endurance, placed to mark points on the ground. They must be visible, of fixed location, capable of identification, and possess a reasonable degree of permanence.

The call of a survey for an adjoiner does not necessarily mean that the survey reaches such an adjoiner, or that the adjoiner is to be considered the locating quantity. As Hobby states (page 175):

> When the field notes of a survey call for a fixed or marked object as a part of that survey and in the same call for the lines of another survey—the former is the controlling call; and especially is this so when the line called for is itself of uncertain locality.

In other words, provided a corner can be located, the call for an adjoiner is secondary if the adjoiner's location is in reality a matter of conjecture. This uncertainty of adjoiner location plays a large part in determining the location of strips or areas commonly called "vacancies." Inasmuch as limitation title does not run against a sovereignty, these lands belong to the state of Texas, and regardless of public opinion to the contrary, these vacancies do exist. It is therefore the duty of the land surveyor to make his work complete enough, and to study the existing records thoroughly enough, not only to protect his client but to protect himself as well.

No discussion of Texas land surveying could be complete without mention of the General Land Office at Austin. The surveyor cannot go beyond the information actually in his hands when in the field. The main source of such information is the General Land Office.

It is only fair to give warning that all the rules herein quoted are, to use a common expression, "subject to change without notice." The law is the last guess of the Supreme Court.

Construction of Mississippi River Cut-Offs

By Harley B. Ferguson

Brigadier General, Corps of Engineers; President, Mississippi River Commission, Vicksburg, Miss.

In the last six years, 120 miles have been eliminated from the sinuous channel of the lower Mississippi River. Practically all of this shortening has been effected by a series of 13 cut-offs, of which but one was of natural occurrence. Each of the others was begun by man, and turned over to the river for completion. Between cut-offs, "corrective dredging" was employed to guide the river in its work and to ensure that the effects of the cut-offs would be carried sufficiently far upstream. The project, of interest in any case because of the extensive changes it has wrought in the map of the alluvial valley, is of special technical significance because it marks a complete reversal in the technique of river improvement developed by the Mississippi River Commission in the preceding fifty years. Moreover, in so far as the corrective dredging is concerned, it stands unique.

In this issue, "Civil Engineering" presents the first of two articles by General Ferguson describing the cut-offs and their effects. The present paper is an engineering travelog, which with the aid of U. S. Army Air Corps photographs gives the reader quite literally a bird's-eye view of each cut-off at an early stage of development and as it is today. The second paper, to be published next month, is a concise account of the effects of this improvement program on the length, slopes, sections, and carrying capacity of the river. Together they constitute the first comprehensive presentation of factual data on this project to be released by the Commission for publication.

In June 1932, a program of channel stabilization by cut-offs and other means was initiated in that reach of the Mississippi River from the Red River to the mouth of the Arkansas River. Twelve cut-offs have been opened, which with the natural cut-off that occurred at Yucatan late in 1929, have shortened the river at bank-full stage 115.8 miles. In connection with the making of these cut-offs, the channel has been improved by dredging and by placing sand fills between cut-offs.

The construction of the cut-offs is but one phase of the program. The river has hundreds of thousands of horsepower working every day, moving water, wearing away banks, shifting channels through sand bars, or merely wasting energy in boils and eddies. By cutting across necks and dredging in critical locations, it has been possible to transfer a part of this vast force from abandoned bends to the work of developing a better navigation and flood channel.

In Fig. 1 is shown the location of the various cut-offs. The distance eliminated by each cut, the fall across the neck before the cut was completed, and the date of opening the initial pilot cut in each case are shown in Table I.

Each cut-off has individual features that would be lost if described in a generalized summary. The remainder of this article, therefore, is given over to descriptions of the individual cuts, illustrated by two series of aerial photographs, which include all but two of the sites. All even-numbered pictures were taken in 1935, about the time the cut-offs were opened, while all odd-numbered pictures were taken at the close of the 1938 high-water season. All photographs are taken looking upstream.

Glasscock (Figs. 2 and 3). Glasscock Point is about 20 miles below Natchez. The cut across this point is about 4 miles long and has been one of the more difficult to develop. Scour must occur throughout its entire length before full development is obtained. The middle section of the cut is across an old lake bed, which is plastic and greasy and has effectively resisted erosion. The lower part of the cut is through a hard clay stratum that has eroded slowly.

The initial construction operation was a shallow dragline cut. This involved about 1,000,000 cu yd of excavation, which was removed between January 21, 1933, and March 26, 1933. At the same time, but extending into April 1933, hydraulic dredges moved an additional 1,800,000 cu yd. The 1933 high water was insufficient to open a low-water channel through the cut-off. During the summer and fall of 1933 about 3,500,000 cu yd more were removed by dredging. As the 1934 water came up, it soon became apparent that this would not scour out a channel. Consequently work was begun during this high-flow period to open up a low-water cut. These operations extended through the low-water season up to January 1935, although suspended during the extreme low-flow months, and a total of 3,800,000 cu yd were removed. The 1935 high water did a large amount of scouring, but two or three natural dams remained in the channel. As the 1935 low water came on, the channel held up fairly well, but at extreme low stages the lake bed closed the pilot cut again and almost stopped the flow. This closure can be noted in Fig. 2 at a point about one-third the distance down from the upper end. During 1936 and 1937 about 3,500,000 cu yd were removed from the cut-off in improving the entrance and assisting in the de-

Table I. Cut-Offs Between Red River Landing and Arkansas River

Mileages and Distances Refer to Center-Line of Bank-Full River

Name of Cut-off	Date Opened	Location, Upper End of Cut-Off (a)	Distance in Miles as of Date Cut-off Opened: Across Neck	Around Bend	Net Shortening	Length of Dredged Cut, Ft	Fall Across Neck: At High Water 1929, Ft	At Mean Low Water, Ft(b)
Glasscock	Mar. 26, 1933	722.5	4.8	15.6	10.8	20,800	3.2	3.4
Giles	May 25, 1933	689.5	2.9	14.0	11.1	10,000	4.6	2.8
Rodney	Feb. 29, 1936	663.7	4.1	9.9	5.8	13,000	2.7	2.0
Yucatan	Fall of 1929	638.3	2.6	12.2	9.6	(e)	3.7	2.8
Diamond	Jan. 8, 1933	613.6	2.6	14.6	12.0	9,175	2.2	4.2
Marshall	Mar. 12, 1934	587.0	3.1	7.3	4.2	13,600	2.4	2.2
Willow	Apr. 8, 1934	564.0	4.7	12.4	7.7	22,000	4.0	3.7
Sarah	Mar. 23, 1936	518.3	3.2	8.5	5.3	12,600	2.2	3.0
Worthington	Dec. 25, 1933	505.7	3.8	8.1	4.3	17,600	3.7	1.6
Leland	July 8, 1933	472.2	1.4	11.2	9.8	(f)	4.3	3.4
Tarpley	Apr. 21, 1935	461.2	3.6	12.2	8.6	13,000	1.8	3.4
Ashbrook	Nov. 19, 1935	443.9	1.9	13.3	11.4	4,530	5.4	2.8
Caulk	May 13, 1937	406.1	2.0	17.2	15.2	4,400	2.9(c)	5.8(d)
Totals			40.7	156.5	115.8	140,705	43.1	41.1

(a) River miles below Cairo, Ill., 1913 Survey mileage. (b) As of date of opening cut-off. (c) 1937 high water fall = 4.7 ft. (d) Actual fall on August 28, 1936 = 10.6 ft at low water. (e) River broke into channel of Big Black River. (f) River broke into old blue hole.

velopment. This has resulted in a channel that carried both high- and low-water navigation in 1937. Figure 3 shows the cut during the 1938 high water. There has been some closure of the old river bend at the upper end but very little deposit below the cut-off.

Giles (Figs. 4 and 5). At Giles Cut, a short distance above Natchez, another difficult situation was encountered. To look at the map it would appear that one or two deep furrows made with a plow across the neck would probably result in a cut-off. In fact, a cut had long been feared at this location, and both revetment and a dike had been built to prevent it. A shallow dragline cut across the point was begun March 24, 1933, and completed May 22, 1933, about 800,000 cu yd being removed. To facilitate its development, the cut was enlarged by dredging at the same time, and about 1,200,000 cu yd of additional material were removed. The 1933 high water flowed through the cut, but when the water went down, the bed did not scour to form a low-water channel. Cypress forests were buried in the bottom of the cut, and they were cemented into an effective dam by hard blue mud. During the summer and fall of 1933 about 2,000,000 cu yd more material were removed by hydraulic dredges. The 1934 high water was not sufficient to dislodge this natural dam, and during the low-water season no flow took place in the channel. During the 1934 season 7,000,000 cu yd were cut out by 27-in. hydraulic dredges, and on October 10, 1934, low-water flow passed through the cut. A gradual development has followed, and during the 1935 low water, about 40 per cent of the total flow passed through the cut without additional dredging. In 1935 (as can be noted in Fig. 4), the cut was still rather narrow for navigation but was used as an alternate route.

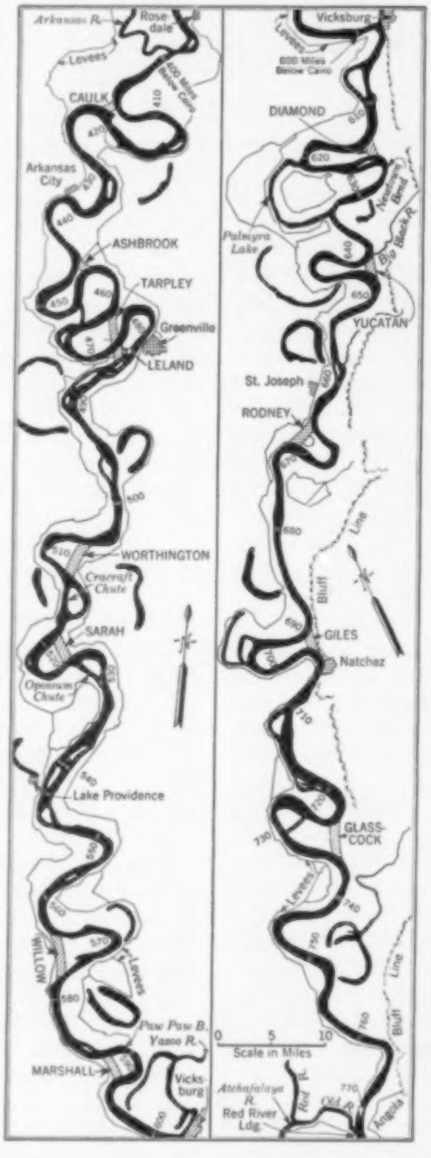


FIG. 1. MISSISSIPPI RIVER CUT-OFFS

Since 1935 there has been a considerable widening in the upper part of the cut, a downstream movement of the sand bar into the old bend above the cut, and some slight evidence of sand deposit below the cut. During 1936 and 1937 about 6,500,000 cu yd of material were removed in assisting the development of the cut and improving the entrance. This has resulted in such enlargement that most of the low-water flow in 1937 passed through the cut-off. Figure 5 shows the cut during 1938 high water.

Rodney. Rodney Point is located a short distance downstream from St. Joseph, La. A cut-off at this location was begun during the latter part of the 1935 high water. A pilot-dredge cut about 250 ft wide was completed on February 29, 1936. About 2,500,000 cu yd were excavated in the pilot cut and about 2,000,000 cu yd have been removed at various times in improving the entrance and assisting the river in enlarging the pilot cut. The fall across the neck was relatively small and the development has not been extremely rapid although it has proceeded in a very satisfactory manner. The cut has deepened considerably without excessive widening.

Yucatan (Figs. 6 and 7). Yucatan Cut-Off was made by the river itself during the fall of 1929. It was unusual in that it resulted from low-water caving and accidentally formed an alinement that was favorable for improved river conditions in the reach of the river in which it was located. In fact it might be termed the illustration which helped to point the way and allay fears as to the terrible catastrophes that would inevitably result from cut-offs. Its development has progressed gradually without requiring any dredging. The 1935 low-water season found the old channel closed off up to 25 or 30 ft above low water, with all the flow below this stage passing through the cut-off. No serious maintenance dredging problems have developed either below or above the cut. The cut-off is extremely deep, with relatively low velocities at low water. In Fig. 6 the complete closure of the upper entrance to the oxbow lake may be noted as well as the practically complete closure of the lower end. Although no dredging has been done in Yucatan Cut-Off itself, during the high water of 1937 the sand bar closing the entrance to the old bendway channel was raised in elevation to above bank-full height for a part of its length by a dredge fill. Only a narrow opening at the downstream side of this bar was left open to permit flow to enter the bendway above a 30-ft stage. Figure 7 shows the cut-off during the 1938 high water.

Diamond (Figs. 8 and 9). Diamond Cut was the first to be constructed under the new program. It is a short distance below Vicksburg and was opened January 8, 1933. It returned the river to an old channel in Newtown Bend, which it had abandoned in favor of a slightly shorter route through Palmyra Lake. A number of interesting developments have occurred. First, as the cut deepened through natural scour, it was found that the bottom became remarkably uniform. This indicated that there must be something hard at this elevation. Check borings later showed that there was a layer of limestone rock about 50 ft below low water—just below the limit of the borings taken prior to the dredging of the cut. A low-water depth of 45 to 50 ft is satisfactory; however, it may somewhat retard the development of the cut.

In the years that the main channel followed Palmyra Lake much sand accumulated in Newtown Bend, and since the opening of the cut it has been a slow process to work this sand out. Until 1935 it was not practicable to carry low-water navigation through this reach below the cut. During falling stages after the 1935 high water considerable maintenance dredging was conducted, and an alternate navigation route through the cut-off was made possible during the 1935 low-water period. In the cut-off itself about 800,000 cu yd of material were removed by a hydraulic dredge to improve the entrance in August and

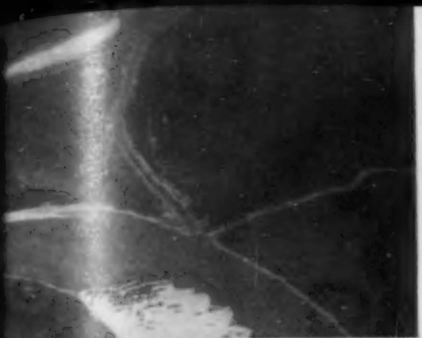


FIG. 4

FIG. 6

FIG. 5

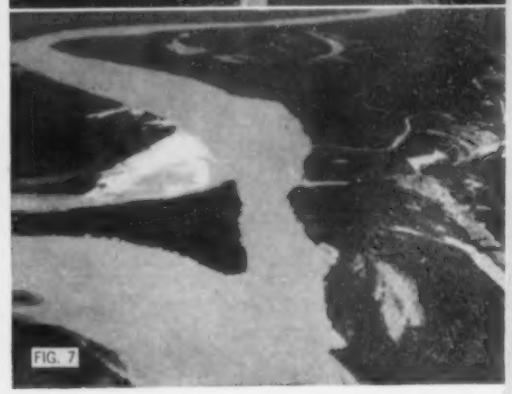


FIG. 7

FIG. 10

FIG. 12

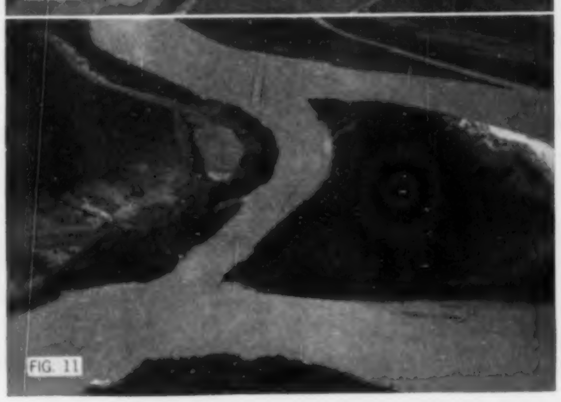


FIG. 11

FIG. 13

FIG. 16

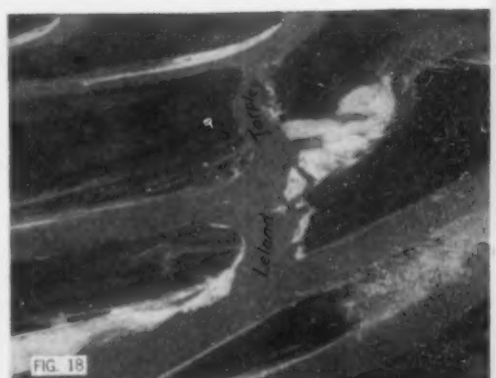


FIG. 18

FIG. 17

FIG. 19

September 1934. The cut showed a gradual development and during the summer of 1935 carried slightly less than half the total river flow. Figure 8 shows clearly the typical sand-bar development below a cut-off that has blanketed the caving bank. This type of blanket bar builds out rapidly and is usually quite high.

Development of Diamond Cut-Off has progressed in a satisfactory manner since 1935 although it has not enlarged as rapidly as the cut-offs in the Greenville Bends. During the summer of 1937 about 1,500,000 cu yd were dredged at the entrance to improve the alinement. Figure 9, taken during the 1938 high water, shows the sand bar in the left background which is gradually closing off the old channel above the cut. About the center of the picture may be seen the artificial sand fill which closes the lower part of the old channel. This fill prevents reverse flow at medium stages from by-passing the channel below the cut-off and taking the old route through Palmyra Lake.

Marshall (Figs. 10 and 11). Marshall Point is about 13 miles above Vicksburg. Erosion on Paw Paw Bend, opposite the point through which the cut was made, had become so severe that it was a case of either revetting this bend or making the cut-off. The decision was to make the cut-off. The method of construction was to make a shallow pilot cut across the upper part of the point by draglines and later enlarge to a small extent by dredging. Across the lower part of the point the initial pilot cut was made with a large hydraulic dredge. The dragline cut was begun October 19, 1933, and completed December 17, 1933; the total excavation amounted to 1,800,000 cu yd. The pilot cut at the lower side of the point required 2,850,000 cu yd of excavation, and the enlargement of the upper cut about 500,000 cu yd. During the summer of 1934 a sand bar formed in the entrance to the cut. This was removed, involving about 400,000 cu yd of excavation, and it has not reformed. Figure 12 is an aerial view of the cut during the 1935 low water.

Marshall Cut has been one of the most unusual of all the cut-offs. Although the fall across the neck was slight, it has developed without any assistance since 1934, and now carries the entire flow at low stages. As can be seen from Fig. 11, taken during 1938 high water, the channel developed has been quite uniform and is also deep at low water.

ONE OF THE LONGEST CUTS

Willow (Figs. 12 and 13). Willow Cut, about 36 miles above Vicksburg, was one of the longer cuts undertaken. It was anticipated that this channel would be somewhat hard to develop, but Old Man River is a contrary individual at times, and in this instance decided he would put forth his best efforts to cooperate in the work. Hence by the 1935 low-water season the regular navigation route and 50 per cent of the total river flow went through the cut-off. The method of construction was to make a shallow cut across the point with draglines and enlarge this by dredging. The dragline cut was begun on November 19, 1933, and was completed January 26, 1934, a total of 2,400,000 cu yd of material being removed. During 1934 about 8,000,000 cu yd more were removed by four hydraulic dredges. A chute at the lower side of the cut was closed off, and a long channel was dredged across a sand bar below the main cut (note these features in Fig. 12). For a time during the 1935 high water it appeared that there might be difficulty with the channel across the sand bar. As low water approached, however, the channel shaped up nicely, and a suitable navigation channel resulted without any maintenance dredging. It should be noted that this channel not only cuts across the sand bar but is almost as wide as the river below.

Since 1935 the only enlargement required was about 1,250,000 cu yd of dredging at the upper end to remove a hard clay ledge that prevented this section from developing in step with the remainder of the cut. Figure 13 shows the cut during the 1938 high water. Almost the entire low-water flow passes through the cut-off.

Sarah. Sarah Cut is shown in the center of Figs. 14 and 15. It is located about 13 miles (air line) above Lake Providence, Ark., and immediately below Cracraft Chute. In Fig. 14, the pilot cut is shown in the initial stage of construction. Cracraft Chute appears in the background, and below the cut in the right foreground is Opossum Chute, which is also being enlarged to carry the main river. In reality the entire reach (Worthington Cut—Cracraft Chute, Sarah Cut, and Opossum Chute) forms a single channel realinement project. About 4,500,000 cu yd were excavated in constructing the pilot cut at Sarah which was made in the conventional manner with cutter dredges. About 7,000,000 cu yd additional have been removed in enlarging this cut. As the fall across the neck was not great and the development of the cut has required the development of both Cracraft and Opossum chutes to keep pace with it, the enlargement dredging required has been relatively large. There has been considerable closure of the old bendway channel at the upper end of the cut by sand bars, and the blanket bar downstream from the cut has already closed off a part of the channel below the cut and has assisted in the development of Opossum Chute.

DIFFICULTIES AT WORTHINGTON

Worthington (Figs. 16 and 17). There is a sharp bend in the river opposite Worthington Point. This bend has been protected by revetment for many years, but severe river erosion has continued and as a result there has been a constant heavy expense for repair and replacement. To eliminate this bend, Worthington Point cut was constructed; it was first opened in December 1933, as a levee machine cut, which required some 3,000,000 cu yd of excavation. Although largely in sand, development was slow. From March to July 1934, about 8,000,000 cu yd of additional material were removed by two hydraulic dredges. In spite of this, however, the low-water flow through the cut was small. During the 1935 high water considerable enlargement occurred, but it was largely widening with no great amount of deepening. Toward the end of this high water a sand bar started to form on one side at the entrance. This was dredged out, but as the river fell to low stage the head of the cut was partly closed (note this on Fig. 16) and only a small amount of low-water flow passed through the channel during the 1935 low water.

Since November 1935, about 4,500,000 cu yd of dredging have been required for development. The cut-off has shown a tendency to widen in the soft sandy material through which it flows, and to move downstream at the head. Figure 17 shows the cut in May 1938. During the 1937 high- and low-water seasons a channel was developed across the bar above the cut-off which materially improves the alinement and in conjunction with further dredging in the cut should result in more favorable development. Below the cut the usual blanket bar downstream from the cut-off has practically closed off the old bendway channel and assisted in the development of Cracraft Chute, formerly a secondary channel which has been made the main river.

Leland (Figs. 18 and 19). A cut-off at Leland Neck had threatened for many years. To prevent this, vari-

ous dikes had been built and a considerable amount of revetment had been placed on the upper side of the neck. In 1930 a pile dike was built on the point during high water to prevent the river breaking through into some "blue-holes" that had been formed by the 1929 high water. (The term "blue-hole" is used in the Mississippi Valley to denote a basin-like depression that is scoured by a rush of water through a levee break.) Toward the end of the 1933 high water a break occurred in this pile dike and a cut-off channel developed most of the way across the point. To aline this channel properly, a small amount of additional excavation was made, which resulted in a low-water channel across the point. This developed rapidly and carried about 40 per cent of the flow during the 1933 low-water season. Following the opening of Tarpley Cut during the 1935 high water, further development occurred and all the flow passed through the cut during the latter part of the 1935 low-water season. This cut has relieved the attack on the Greenville front and places Greenville on an oxbow lake, a short distance from the main river. No work has been done on Leland Cut since it opened in 1933, and it now carries the entire flow of the river below bank-full stage.

FIG. 20

FIG. 21

Tarpley. Tarpley Cut, a short distance above Greenville, is also shown on Figs. 18 and 19. Tarpley Neck had been subject to erosion for many years, and a natural cut-off had threatened in this location for some time. In 1932 revetment was placed on the upper bank, and blue-holes on the neck were filled with earth to forestall a possible cut-off. Erosion continued, however, and after Leland Cut was made, it became apparent that failure to complete Tarpley in the near future might return the river to the Greenville front, with subsequent return of attack against the revetment at this location, which had been relieved by Leland Cut-Off. Consequently work on Tarpley Cut was initiated on January 29, 1935, and completed on April 21, 1935. A total of 5,000,000 cu yd were dredged. The pilot channel was largely in sand, and the cut developed quite rapidly to carry about 65 per cent of the flow during the 1935 low-water season. The procedure followed was to dredge a pilot cut about 40 ft deep and 250 ft wide, which after completion was enlarged by natural scour. In Fig. 18, showing 1935 low-water conditions, it is interesting to note the large sand deposits in the entrance to the old bend channel below the cut-off.

A FRESH-WATER LAKE FOR GREENVILLE

Since 1935 the only dredging done was during the 1937 low water when about 1,500,000 cu yd of material were removed to improve the channel in the lower part of the cut and encourage the development of a more satisfactory alinement through this reach of the river. Figure 19 shows Tarpley Cut, with Leland Cut in the foreground, during the 1938 high water. The downstream end of the old channel below Tarpley filled rapidly, and was later closed to levee height by a dike extending from the levee above Tarpley Cut across the old channel of the river, thence across Leland Neck, and again across the lower part of the old channel to an island in the river below Greenville. This dike, which shows prominently in Fig. 19, provides the city of Greenville with a fresh-water lake for navigation and recreation, entrance to which is gained at the lower end. In the upper left part of Fig. 19 may be seen the chute of Island 82 which still diverts a part of the flow around Tarpley Cut-off.

THE END OF THE GREENVILLE BENDS

Ashbrook (Figs. 20 and 21). Ashbrook Cut is a short distance below Arkansas City and was opened on November 19, 1935. The neck through which the cut was made formed the upper point of the famous Greenville Bends, and as the huge hydraulic dredge tore away the sandy bank these bends passed into history. Where five sharp turns have marked this reach of the river for many years past, two sweeping bends now replace the old alinement and the Greenville Bends are no more. They were troublesome bends, and it cost considerable sums to protect them with concrete, willow, and stone. On Ashbrook Neck a dike had been built to protect it and hold the water back; the present cut-off severs this dike as well as the neck of land and speeds the water on to the Gulf. The part of the cut completed on October 25, 1935, shows clearly in Fig. 20. No additional dredging has been done at Ashbrook Cut since the cut-off was completed. Figure 21, taken during 1938 high water, shows the development that has taken place. The upper end of the old channel around the bend has closed off entirely for low and medium stages. The cut-off has enlarged and deepened until it is practically the main river. A blanket sand bar has built downstream from the base of the neck, masking the caving bank below the cut-off. A new channel has cut across the old sand bar point below the cut and a generally improved alinement has resulted.

Caulk. Caulk Cut was the last one to be made in the lower river. It is located about 5 miles downstream from the mouth of the Arkansas River and was opened following the 1937 high water on May 13, 1937. This cut shortened the river by 15.2 miles, and in part because of the lowering produced by cut-offs below, it had the greatest drop across the neck of any cut attempted up to the date of its opening. During the 1936 low water the actual fall across this neck reached a maximum of 10.6 ft. At the time the cut was opened the actual fall was about 8 ft. The cut was constructed in the normal manner by dredging a pilot channel across the neck with a cutter dredge. About 1,500,000 cu yd were dredged during the months of April and May and in enlarging the pilot cut during May and June. During the remainder of the low-water season the cut enlarged by natural erosion to such an extent that late in the fall low-water navigation both up and downstream was routed through it. The pilot channel was cut only across the higher part of the neck and the river itself scoured a channel across the bar comprising approximately the lower half of the neck.

Building Regulations in the United States

By Robins Fleming
American Bridge Company, New York, N.Y.

From earliest times the erection of proper and safe buildings has been considered a matter of public concern, not to be left to the whim, or possibly the easy conscience, of selfish householders. Instead codes have been multiplying, beginning with the Mosaic laws, until in the United States alone they are now said to number more than 1,500. Dr. Fleming here reviews this development, its purpose and sponsors, with something of present trends. The story has value for its general information or as a preliminary to further study.

One of the earliest building regulations on record is found in the Mosaic Code, which reads, "When thou buildest a new house, then thou shalt make a battlement for the roof, that thou bring not blood upon thy house, if any man fall from hence" (Deuteronomy 22:8). Even this ancient regulation was antedated several hundred years by the drastic laws of Hammurabi, King of Babylon. Death of the builder was the penalty exacted if the house collapsed killing the owner. If the son of the owner was killed, the son of the builder was to be put to death.

In England the first building ordinance is claimed to have been in London, where in 1189 it was enacted with other regulations that party walls must be of stone, 3 ft thick and 16 ft high. The earliest ordinance in what is now the United States is one of the city of New Amsterdam, now New York, for which the original document is in the New York State Library, in Albany. It is dated July 25, 1647, and relates mostly to private trespassing upon public property. A history of New York building regulations from this simple beginning of 290 words to the present building code of approximately 250,000 words, promulgated in 1937, would fill a volume.

It is only 25 or 30 years since the study of building regulations was taken up in earnest. In 1913 I made a review of the building codes of 35 cities, which showed surprising differences in requirements for the steel framework of buildings. Wind pressure, which of late has received much attention, was ignored in a number of codes; for example, those of Boston, Cambridge, Haverhill, and New Orleans specified that "provision for wind bracing shall be made wherever it is necessary." A specified horizontal wind pressure of 30 lb per sq ft was common. Chicago and San Francisco specified 20 lb per sq ft.

WIDE VARIATION IN CODES FOUND

A later tabulation, made in 1918, covering the live loads specified for office floors in the codes of 130 American cities, showed wide variation. Two cities, Milwaukee and Fort Worth, specified 40 lb per sq ft; ten, including Chicago and Cincinnati, 50 lb; sixteen, including New York and San Francisco, 60 lb; one, East Orange, N.J., 65 lb; seven, including Denver and Pittsburgh, 70 lb; fifty-eight, including Baltimore and Providence, 75 lb; one, Cleveland, 80 lb; one, Youngstown, 90 lb; and eleven, including Boston and Philadelphia, 100 lb. A number of codes were general or fragmentary in their provisions.

It was not only in specified floor loads that a wide variation was found—working stresses also varied greatly. Allowable shear in webs of plate girders ranged from 7,000 lb per sq in. (Buffalo) to 10,000 lb per sq in. The straight-line column formula, $16{,}000 - 70\ l/r$ for steel, predominated. A few codes contained the meaningless statement that "every column is to be of sufficient strength to bear safely its intended load." Specified wall thicknesses were often wasteful. About 25 cities retained a requirement of an earlier New York code that brick enclosure walls between iron and steel columns, supported wholly or in part on iron or steel girders, must be not less than 12 in. thick in the upper 75 ft of height, and in each 60-ft section below this, 4 in. thicker than in the section next above. The engineer who designed the steelwork of the Hotel McAlpine, New York, N.Y., estimated that 800 tons of steel could have been saved had it not been for this foolish requirement of the code.

In the United States there are a hundred cities with a population of more than 100,000, of which each has its own building code. In addition there are several hundred other municipal, state, and regional codes. It needs but a cursory comparison between these codes and those of 25 years ago to show that, notwithstanding imperfections, great improvement has been made. Three influences have acted powerfully in bringing about this advance.

In the U. S. Department of Commerce, a Building Code Comittee was organized early in 1921 in recognition of a public demand for greater uniformity and economy in building code requirements. Its personnel was of a high order. As a preliminary step, the live-load requirements of 109 existing codes were compiled. A variation of 100 per cent in allowable floor loads for the same occupancy was found to be common. The committee's report, dated November 1, 1924, to Herbert Hoover, then Secretary of Commerce, was embodied in a booklet of 28 pages entitled, "Minimum Live Loads Allowable for Use in Buildings."

In 1934 the work of the committee was turned over to the American Standards Association through its Building Code Correlating Committee. The Society has official representation on this committee. A monograph of the association, issued July 23, 1937, begins, "Numerous requests are received for recommended material in preparing or revising local building codes. With the exception of the reports of the Department of Commerce Building Code Committee, which it has accepted as a basis for its work, the Correlating Committee has expressed no opinion on the merits of existing recommendations. Eventually, it expects to have a series of recommendations of its own, prepared by sectional committees on all the subjects customarily covered in building codes." Much is expected from this committee.

In 1923 a second organization, the American Institute of Steel Construction, undertook the work of promoting sound and uniform practice in the steel industry. Their manual, *Steel Construction* (third edition, October 1937, 398 pages), is a veritable mine of information. Part IV, "Standard Specifications and Codes," includes the specifications of the American Society for Testing Materials and the code for fusion welding and gas cutting of the American Welding Society. Of special importance to the structural engineer is a "Specification for Design,

Fabrication, and Erection of Structural Steel for Buildings."

The institute took the lead in raising the basic working unit stress of steel to 18,000 lb per sq in. The 1936 specification adopted 20,000 lb per sq in. to take advantage of the improved quality of steel being rolled. The annual report of the year ending September 30, 1937, states that 183 cities had adopted, and 83 cities were permitting, the 18,000-lb specification; and that 171 cities had adopted, and 109 cities were permitting, the 20,000-lb specification.

A third influence was the National Board of Fire Underwriters. Its building code appeared as a first edition in 1905. The revised reprint of the fifth edition is dated 1934. Like the manual of the American Institute of Steel Construction, its 316 pages hold a wealth of information. Being written from the standpoint of the fire insurance companies, "it contemplates the prevention of fire, and not merely protection against it." As stated in the foreword, "Practically every good-sized municipality in the Union used early editions of the National Board Building Code in the framing or revision of their building regulations; and many municipalities adopted it in its entirety or used considerable portions of it."

The year 1937 marked a notable advance in building control. A new building code for New York City, enacted to become effective January 1, 1938, was the result of study by a committee which included engineers, architects, builders, and renting agents, all prominent in their respective fields. It may be noted that the building code of no other city in the world is as far-reaching in its influence as that of the city of New York. Progress was made in the proposed new code for Chicago. The revised Uniform Building Code of the Pacific Coast Officials' Conference was published under the date of April 1937. Important changes were made in other codes. In the framing of new codes, or the revision of present ones, those of New York, Chicago, and the Uniform Building Code will surely be consulted. Small cities usually follow the codes of large cities as far as practicable—and sometimes where not practicable. It may not be out of place to call attention to five government "Publications Relating to Building Regulation," that can be obtained for a small sum from the Government Printing Office: "Recommended Minimum Requirements for Small Dwelling Construction," "Recommended Minimum Requirements for Plumbing," "Recommended Minimum Requirements for Masonry Wall Construction," "Minimum Live Loads Allowable for Use in Design of Buildings," and "Recommended Minimum Requirements for Fire Resistance in Buildings."

It is of interest that some building code requirements are due to previous disasters. The Los Angeles code has rigid earthquake prescriptions. The 1937 Miami building code calls for a normal wind pressure of 45 lb per sq ft on the entire surface of buildings more than 75 ft in height. California earthquakes and Florida hurricanes were evidently in the minds of the compilers of the respective codes. Since the Iroquois Theater fire on the night of December 30, 1903, when nearly 600 people lost their lives, it has been a universal requirement that exit doors in public buildings should open outwards. Even freak or peculiar requirements are occasionally found in a building code.

Few men in America have been greater students of building codes than Dr. Fleming. For details of the various phases treated here reference may be made to some of his writings over the past 25 years, as follows:

"Municipal Building Laws in the United States," Engineering News, Vol. 70, July 3, 1913, p. 9

"Wind-Bracing Requirements in Municipal Building Codes," Engineering News, Vol. 73, March 11, 1915, p. 485

"The Skyscraper and Building Heights in the United States," Journal of the Western Society of Engineers, Vol. XXIII, June 1918, p. 422

"Suggested Reforms in Floor Load Requirements of City Building Laws," Engineering News-Record, Vol. 80, June 27, 1918, p. 1227

"Puzzling Variations in Important Building-Law Clauses," Engineering News-Record, Vol. 81, September 26, 1918, p. 579

"Building Codes in the United States," Engineering, Vol. CXLII, December 25, 1936, p. 688

"The New York City Building Code," Engineering, Vol. CXLIV, August 27, 1937, p. 235

A UNIFORM BUILDING CODE

It is said that there are 1,500 or more codes in existence today. Some are only a few pages in length. The Miami, Fla., "Building Code Book" (1937) contains 528 pages of text and 70 unnumbered pages of contents and index. In addition there are cuts and plates illustrative of the text.

Efforts have been directed of late to the framing of a uniform building code. State building regulations are in effect in a number of states but usually they are rather limited in their application. The New England Building Officials' Conference in 1937 proposed a standard code for that region. A conference at Ottawa, December 10, 1937, approved the preparation of a model building code for Canada.

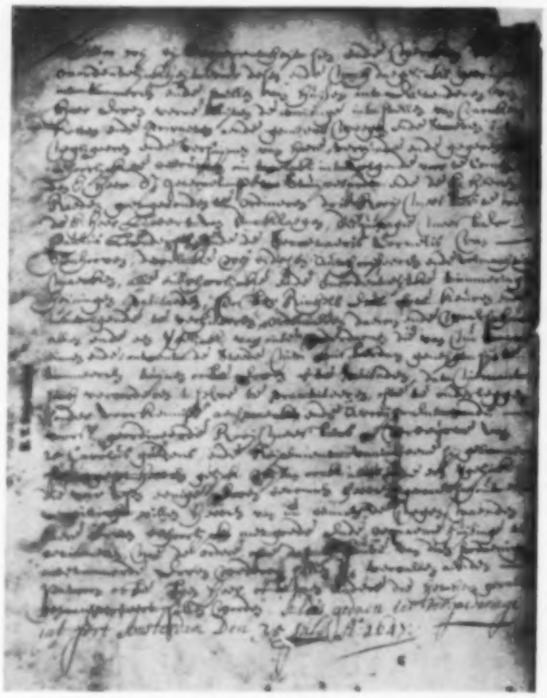
The most prominent of the efforts to formulate such a code are those of the Pacific Coast Building Officials' Conference. The first issue of their Uniform Building Code was in 1928; the revision of 1936 was published under date of April 1937. The sponsors claim it "represents the first complete building ordinance that has ever been prepared jointly by such a large number of cities together with the combined assistance of practically every national technical, research, and trade organization and governmental bureau in the United States cooperating." Its 326 pages, $5^1/_4$ by $7^3/_4$ in., are divided into 11 parts and 49 chapters, with an appendix of 25 pages containing "suggested ordinances covering subjects which may not be desired in all cities, also other pertinent information designed to be of assistance to the building inspector." The outline of contents by parts, chapters, and sections at the beginning of the book, and the index at the end, are models of their kind.

A distinctive feature of the code is its reference to requirements of national organizations. The texts of these references are not printed in the code but are reprinted in a book, *Specification Documents*, to which, as well as to the original source, reference is made throughout the code.

The single sentence of Section 1802 reads, "The height of Type 1 buildings shall not be limited." Type 1 buildings are those of fire-resistive construction, which class includes the skyscraper, the distinctive American contribution to architecture. From the very first, limiting the height of tall buildings has been a subject of regulation. The limit has varied greatly in different cities, and in the same city at different times. The Uniform Building Code places no limit on the area or on the height of fire-resistive buildings. (The specified meaning of "fire-resistive" should be noted.) It is observed that the

basic unit working stress of structural steel is 20,000 lb per sq in. In the New York City code it is 18,000 lb per sq in. I venture the opinion that at no distant date this will be changed to 20,000 lb per sq in.

Building Standards Monthly, the official organ of the Pacific Coast Building Officials' Conference, in its August 1938 issue lists 210 cities and counties operating under the Uniform Building Code. Of these, 146 are in California. Among cities in other states are Birmingham, Denver, Peoria, Topeka, Lincoln, Utica, Austin, Dallas, Houston, Salt Lake City, and Ogden. Honolulu in Hawaii has also adopted the code. Of the whole number, 115 have adopted the 1937 code or signified their intention to do so. The population of the area in which building is controlled by this code is given as 5,991,000. The population of the area controlled by the New York City code is over 7,000,000; that by the Chicago code is near 3,500,000.



THE EARLIEST BUILDING REGULATION IN WHAT IS NOW THE UNITED STATES WAS DATED JULY 25, 1647

Translation (Abridged): "Whereas we see the irregularity in building of Houses, in extending of Lots far beyond the survey line; in setting up Hog pens and Privies on the highways; the Hon'ble Council have Resolved to appoint three Street surveyors whom we empower to condemn and in future to stop all unsightly and irregular Buildings, etc. Therefore, we Order and warn all our Subjects who are inclined to build on or inclose any Gardens or Lots within or near the city *New Amsterdam*, not to proceed without survey by the aforesaid Surveyors, under a fine of 25 Carolus guilders and the abatement of what they have set up."—From *Laws and Ordinances of New Netherland, 1638–1674*, Compiled and Translated by E. B. O'Callaghan (1868). Original Document Is in New York State Library at Albany

A MODEL BUILDING CODE

The "Dedication" of the Uniform Building Code of the Pacific Coast is right to the point as to what should be the aims of a building code. It should be "dedicated to the development of better building construction and greater safety to the public, through the elimination of needless red tape, favoritism and local politics by uniformity in building laws; to the granting of full justice to all building materials on the fair basis of the true merits of each material; and to the development of a sound economic basis for the future growth of cities through unbiased and equitable dealing with structural design and fire hazards."

In the foreword of the Fire Underwriters' building code Charles Derleth, Jr., M. Am. Soc. C.E., says: "It is not enough to prepare a building code or city ordinance to ensure strength and stability of buildings. Of equal importance are the requirements of fire resistance, fire prevention, exposure, public health, ventilation and such broad questions of public and private welfare as equipment, occupancy, rentability, etc."

Certain requisites in the wording of a model code can be stated without fear of contradiction. Clearness of expression is one. No clauses should require an explanation of their meaning. Requirements should be definite. Questions likely to arise should be answered by the code rather than by a building official. A building code presupposes trained architects and engineers who know how to do their work; it cannot replace experience. Its rules "cannot produce or supersede judgment; on the contrary, judgment should control the interpretation and application of rules."

Pertinent questions can be asked regarding the building code of any city. Is it fair to all concerned? Are any requirements obsolete or unnecessarily severe? Are undue restrictions placed upon the use of any worthy material? Are new methods of construction ignored? In a word, is the code up to date?

The framing of a new building code, or the revision of a code in force, should be a subject of much thought and study. With all the help of excellent codes that have been enacted and become law, still to be considered is the question of how far they are adapted to the particular case in hand and the extent to which they can be quoted. The July 1937 monograph of the American Standards Association, previously quoted, is entitled, "Information on Sources of Material for Use in Preparing and Revising Local Building Codes." It describes, and tells how to obtain, publications bearing on building regulations put forth by responsible organizations. The compilers are careful to say, "The extent to which the material should be incorporated in codes is a matter for the judgment of officials or committees undertaking the local work." For the officials of a smaller city this problem of selection is particularly difficult of solution. The building code of Cincinnati, adopted April 1, 1933, is a volume of 407 pages. The "Supplement of Additions and Amendments to January 13, 1937," adds 52 pages. Standard regulations of national organizations are given by reference. Had the references been printed in full the code would consist of four volumes instead of one. In the smaller city the architect and engineer would encounter difficulty, delay, and expense if this method were followed. The framers of the code would probably regard publishing the references in a book of reprints, like "Specification Documents of the Uniform Building Code," to be an unwarranted expense.

In a model building code the prospective growth of the city for which it is written should be taken into account. Turning to the U. S. Censuses of 1910, 1920, and 1930, it will be seen that the population of Akron, Ohio, has increased successively from 69,000 to 208,000 to 255,000; that of Dallas, Tex., from 92,000 to 158,000 to 260,000; of Flint, Mich., from 38,000 to 91,000 to 156,000; of Detroit, Mich., from 465,000 to 993,000 to 1,568,000. The increase for New York, Chicago, and Philadelphia was about 25 per cent for each ten-year period. Scores of towns became cities.

Growth brings new conditions, especially when the growth is abnormal; with the introduction of new materials, new processes of fabrication, and new construction methods, it requires repeated revision of building codes.

Drainage of Irrigated Lands

Continued Productivity of Soils Depends on Avoiding Accumulation of Soluble Salts

By A. W. Walker

Associate Member American Society of Civil Engineers
Superintendent, U. S. Bureau of Reclamation, Fairfield, Mont.

THROUGHOUT the arid regions, irrigators must be constantly alert to the "alkali problem"—the accumulation in the soil of soluble salts that render it sterile. In some cases, a protracted period of leaching will restore fertility; in others, local applications of chemicals have proved effective. Oftentimes a drainage system may be required, in addition, to induce the essential downward movement of water through the soil. All these points are discussed by Mr. Walker in the present article, which is an abridgment of his paper on the Irrigation Division program at the 1938 Annual Convention.

IRRIGATION structures are built to last for generations, and it is clearly the expectation that the lands served by them will continue to be productive as long as the works shall stand. Yet the experience of little more than half a century discloses a real danger that some irrigated lands may become unproductive within a few years. The cause of this uncertainty as to the future is found in the "alkali problem."

In the ordinary practice of irrigation the aim is to apply the water uniformly to the surface of the land. The implication is that if the water is applied uniformly, it will soak into the ground uniformly in each check or along each furrow. As a matter of fact, this does not happen. The soil as it occurs in the field is anything but uniform in texture and permeability. These differences are often very great at points only a few feet apart. Thus the water penetrates readily in some parts of the field or check, and very slowly and only to a short distance in other parts; and there is a tendency for initial diversities to be exaggerated with the passage of time and with repeated applications of water. The water applied to the field carries dissolved material—often in substantial quantities. Some of this water is used by the growing crops, but a large part of it is lost by evaporation from the soil. In either event the dissolved material is deposited in the soil. Where permeability is good and an adequate quantity of water is applied, there is at least a small surplus to percolate downward beyond the root zone and beyond the range of evaporation. But in less permeable spots, the soluble material accumulates in the surface soil or at the lower limit of water penetration.

Recognition of this diversity in permeability is essential to an understanding of how irrigated fields become unproductive and why it is often difficult to reclaim them, even when irrigation water is used in excess of crop requirements and evaporation losses. A field of saline soil may be provided with an adequate drainage system, it may be heavily irrigated, and there may be a free discharge of water from the drains, yet a large part of the field may remain unproductive.

An investigation of such a situation is likely to show that the leaching effect of the irrigation is confined to those spots where the soil is permeable. In the remainder of the field the water is not moving downward but is held in the soil except as it is lost by evaporation between irrigations. In fields where differences in permeability are not very pronounced, a protracted period of leaching may be effective in removing the soluble material from all parts of the field. This reclamation may be hastened by installing a system of interior borders that will tend to equalize penetration by holding the water longer on those spots where it soaks in more slowly.

It is well to recognize that there are at least two different sets of conditions involved in permeability. One of these has to do with the texture of the soil, and the other with its physical condition, which is largely influenced by the character of its combined bases; that is to say, a soil made up largely of clay and fine silt is less permeable than a soil composed largely of sand, providing both types are in the same condition as regards their combined bases. When a check or border includes both types of soil, it is well worth while to subdivide it by interior borders which conform to these differences in soil type. Such subdivision makes for economy in the use of water whether for leaching the soil or for irrigating crops.

LOCAL APPLICATIONS OF SALTS

Where the differences in permeability within a border are due chiefly to the physical condition of the soil resulting from the character of the combined bases, it is possible to obtain more uniform penetration by making local applications of salts that will improve the physical conditions. For this purpose such salts as calcium sulfate (gypsum) and aluminum sulfate are among the most valuable. Of the two, gypsum is the cheaper and more generally accessible. It has the disadvantage of being less soluble than aluminum sulfate and consequently of reacting more slowly.

It would seem advisable to limit the application of these salts to spots where the soil is impermeable, since the purpose is to obtain more uniform conditions of water penetration. Impermeable spots can be located after a field has been irrigated, by exploring the area with a sharp-pointed steel rod or a soil auger.

There is another condition of impermeability sometimes encountered in irrigated land that differs from those just described in that it occurs in a zone of limited thickness somewhat below the surface of the soil. This condition, which has been referred to as "hardpan" or "plowsole" is sometimes found also in soils that have not been irrigated. The formation of hardpan appears to be due to the precipitation of substances from the soil solution at the point below the soil surface where evaporation takes place. These subsurface impermeable layers often interfere seriously with the penetration of water. When they are not too thick and hard, they are often broken up by deep cultivation; otherwise blasting may be resorted to if conditions justify that expense.

Existence of an underground water table in effect constitutes a barrier to the downward percolation of water through the soil unless drainage conditions are such that the whole body of underground water is free to move. Furthermore, when the underground water stands close to the surface of the ground it suffers losses by evaporation, and consequently deposits its dissolved material

at the point where it evaporates. This deposition of dissolved material from underground water is one of the most prolific sources of trouble in irrigated land.

The movement of water through saturated soils is usually very slow. Consequently readjustments of underground water levels that have been disturbed by additions from percolating water are very sluggish. In the absence of information to the contrary, we find it natural to assume that underground water seeks its level just as open water does. This is no doubt true, but it does so very slowly. If we make a survey of underground water conditions in an irrigated field, we find that the free water stands much higher in some places than in others.

The occurrence of soluble material in irrigated soils in harmful quantities may be taken as a definite indication that the irrigation water does not move downward through the soil. It does not appear to be essential that this downward movement should be continuous or that any large proportion of the water applied to the soil should pass below the root zone. But it does seem certain that at least occasionally some water should do so. Otherwise it is inevitable that sooner or later the soluble substances brought in by the irrigation water, together with those set free by soil disintegration, must accumulate to a harmful degree.

DESIGN OF DRAINAGE SYSTEMS

In planning a system of drainage whose chief function is to relieve an accumulation of underground water, it is not sufficient to consider merely the surface contours. Rather, location of such drains should be determined by underground conditions. Whenever it is possible to do so, the drains should be designed to intercept water that is moving into a section where trouble exists or is anticipated, as well as to provide outlets from such sections. Chemical studies of the water should be helpful in locating the channels of free movement and consequently in determining proper locations for drains.

In the Bureau of Reclamation the following methods are generally followed in investigating seepage. A careful surface and subsurface survey of the affected area is made. A system of wells is laid out, generally on a coordinate basis, so arranged that the wells are about 400 ft apart over the affected area and adjacent lands. Test pits or borings are put down and cased. Profiles or sections are taken on well lines and plotted to show ground surface, ground-water level, and location and log of each well. With these profiles as a basis and with such additional shots as necessary a contour map is prepared. On this map the water elevations in the wells are plotted and the ground-water contours thus determined. With these data on hand the most advantageous drain location can be determined.

In locating the main drains it is well to keep in mind the following principles: (1) The drain should be located so as to get water; (2) it should have considerable slope (so that once the water is in the drain it will prefer to stay there, rather than to seep out into adjacent soil); and (3) it should be located as a main outlet capable of future extensions.

It is important that the general plan of a system be sufficiently comprehensive that it can be made to serve, as outlets at least, for the entire tributary area to be drained. Main drains intended to serve as outlets for several tributary branches, or which for other reasons may be required to carry large quantities of water, should generally be located along lines of greatest slopes in order to avoid losses. (This principle does not apply to small drains intended principally for intercepting water below a source of supply.) Another important requirement, especially with open drains intended to carry large quantities of water, is that they be located, in so far as possible, along lines of uniform slope. Drains constructed with varying slopes tend to erode where slopes are steep and to deposit the eroded materials where they are flat.

Where excess water is the result of a uniformly distributed surface supply, drainage consists in drawing enough water out of the soil to lower the free ground water to the required depth. If the excess results from an underground supply confined in deep pervious strata such as gravel, shale, or coarse sand, drainage is essentially the tapping of an underground supply so as to relieve the pressure which it exerts upon the soil above. This may be accomplished by constructing drains directly into the water-bearing material. The use of relief wells is often resorted to with beneficial results.

The distance a drain will be effective, and the area that will be reclaimed or protected by it, cannot be accurately determined prior to construction. Hence it is not advisable to definitely locate drains too far in advance of construction. It is frequently necessary to observe the results of drains already built before sound conclusions can be reached as to what will ultimately be required. It is extremely important that the engineer in charge maintain an open mind and make necessary changes in the drainage plan as the accumulative results from constructed drains justify.

On irrigated lands the volume of drainage water that must be removed depends largely, and in many cases wholly, on the quantity reaching the soil through irrigation and from canal and lateral losses. Experience seems to indicate that with proper use of water the quantity that must be drained from the soil will not exceed 25 per cent of that applied in irrigation. Where drainage requirements exceed this amount they should be reduced by applying less water to the land or by preventing excessive canal losses.

Comparison of the analyses of underground or drainage water with those of the irrigation water affords a basis for studying the reactions that are going on in the soil, and may make it possible to anticipate and to prevent some of the difficulties that follow the accumulation of harmful quantities of soluble substances. If the quantity of irrigation water used on a certain area, and the drainage discharge from that area, can both be measured, analyses of the two waters make it possible to know whether the land is gaining or losing in salt. Generally in successful drainage systems the proportion of calcium in the drainage system should be less than in the irrigation water. This means that the land has absorbed lime from the irrigation water and has undergone a loss of soda.

It is not possible in advance of irrigation to determine definitely what, if any, areas will be affected by seepage. In many instances, lands that gave the best returns and commanded the highest price for the first few years after irrigation was begun, have been the first to become waterlogged and unfit for use. The owners of affected areas have contributed equally with others in acquiring lands and providing means for irrigation. They are entitled to protection against having their lands rendered worthless, and others who enjoy the advantages of irrigation should share the responsibility of affording such protection. In other words, where an area is brought under irrigation, provision should be made to protect any part of it from becoming seeped and useless as a result of such irrigation, and the cost of protection should be borne by the entire area.

Motor-Vehicle Taxation Rate Making

General Comments, and Summary of Washington Highway Cost Commission Reports

By Lacey V. Murrow, Assoc. M. Am. Soc. C.E.

Director of Highways and Chairman of the Highway Transportation Commission of the State of Washington, Olympia, Wash.

and Bertram H. Lindman, Assoc. M. Am. Soc. C.E.

Engineer Economist, Highway Transportation Commission

Highway transportation has many characteristics of a public utility that must be recognized in the fixing of fair and practicable highway-user tax rates. This concept has already led to the development of a highly specialized technique of rate making. Much as a simple solution may be desired, experience has shown that a tax schedule must be more or less complex if it is to be fair. Public interest introduces two final considerations—one the need of low rates to encourage highway traffic and the other the need of sufficient funds for the construction of safe, adequate highways. In this paper Messrs. Murrow and Lindman first discuss in general the principles of highway user taxation, and then outline in considerable detail the comprehensive studies that have been made by the Washington Highway Cost Commission on this subject.

Fixing of motor-vehicle tax rates is in certain respects a public-utility rate-making problem. And just as the engineer in charge of highway location, design, and construction has long profited by the successes and failures of the railroad engineer, so may those responsible for fixing rates for highway services learn much from the development of transportation utility rates and adapt many tested theories and practices.

Perhaps the first reaction to such statements is that a simple problem is made unduly complicated by bringing in all the paraphernalia of the expert in transportation rate making. But the experience of the Washington State Highway Cost Commission is that much as a simple solution is desired, it cannot be successfully achieved. Rates based on a simple theory bring lobbies of adversely affected interests to legislative halls clamoring for consideration of factors favorable to them. Since their questions must eventually be met, they should be taken into consideration at the time the rate schedule is prepared. Growing recognition of the public-utility nature of the motor-vehicle taxation problem has already led to the development of a highly specialized technique.

In its rendering of unique, personalized services, highway transportation is of course a distinctive public utility. The solution of the problem of fixing motor-vehicle tax rates must therefore be attempted with due consideration for all related problems and their economic, political, and social implications. Some are problems of an internal nature arising from the public ownership of roadways and private ownership of motor vehicles, the administration of roadways by rival public agencies—federal, state, county, and city—and the existence of large and small vehicles and of private and common carriers. Others are external problems arising from competition with marine and railroad transportation and the heritage of unsavory political affinities. As yet so many internal problems remain to be solved that very little consideration has been given to external problems.

Should Local Roads Be Included in Financing System?

One ever-present problem is that of the propriety, from a transportation viewpoint, of applying highway-user tax revenues to local roads that do not feed sufficient traffic to the main roads to defray their cost. Inconsistency results from including these local roads in a system of financing designed to conform to highway transportation principles and practices. Such roads existed long before the advent of highway transportation and, whether located upon or between private lands, are for the direct benefit of the property owner.

Previous to the depression, local property access roads and streets were financed through property taxes. But more recently there has been a shift in general taxation philosophy from the idea of support of government in accordance with benefits received to that of support in accordance with ability to pay. This has enabled the property owner, and particularly the farmer, to argue convincingly that because of his economic condition he should not pay. The net result is that the burden of local roads, rural and urban, is being shifted from the chief beneficiaries and piled upon the highway users, who believe that they are paying only for inter-city and other heavily traveled roads (see Fig. 1). The practical result is that highway engineers cannot provide highway users—the contributors to highway user funds—with the modern, safe highways to which they are entitled.

The impropriety of saddling highway users with local road costs is not apparent to the local road authorities. Neither is it apparent to state authorities for relief, education, pensions, and other worthy public needs. Imbued with the general taxation theory, they consider all governmental revenues as taxes to be pooled for

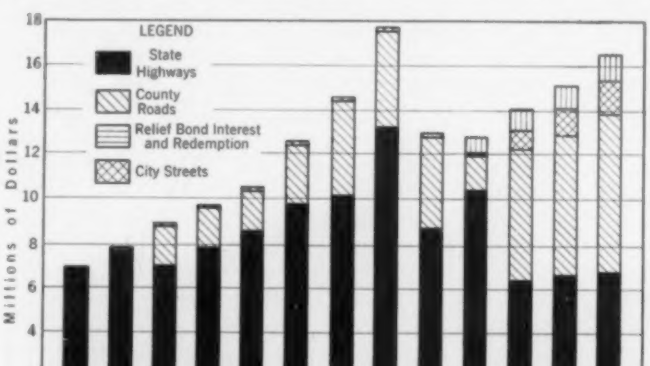


Fig. 1. Trends in the Distribution of Washington State Motor-Vehicle License Fees and Fuel Taxes, 1924–1936

apportionment to any and all governmental functions. When the general taxation theory prevails, the highway engineer must compete with all these authorities for a fair share of the total tax collections. And he is at a disadvantage—for his cold facts of reduced operating

costs, time saved, and benefits to transportation from improved highway location and design cannot outbalance the emotional, social, and political appeals put forth by his opponents.

Other problems that must be considered in adapting public utility theories and practices, particularly those

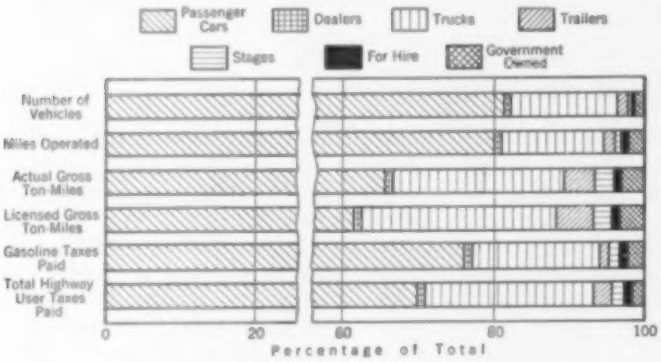


FIG. 2. DISTRIBUTION OF WASHINGTON HIGHWAY SERVICES RENDERED TO ALL VEHICLES, 1935

related to annual cost, arise from differences in financial structure. The privately owned utility has a stock-and-bond method of financing, original and reproduction cost valuations, and depreciation charges and reserves, whereas highway transportation has a limited use of bonds and no stocks, little knowledge of original or reproduction costs, and no reserves for depreciation.

Perhaps the most important difference is the limited use of bonds. Permanent bonded indebtedness is not contemplated, and where bonding is used it is considered only as a temporary source of funds. Hence highway transportation authorities are dependent primarily upon taxes. This fact, and the reluctance of the general taxpayer to provide highway funds, throw the burden of capital outlay on the highway user. When costly structures such as bridges, tunnels, and super-highways prove too burdensome for the highway user, special governmental authorities such as the California Toll Bridge Authority and the Pennsylvania Turnpike Commission are created. These authorities issue bonds and charge tolls in a manner comparable to a privately owned utility. The increasing need for such structures on the one hand, and the improper use of highway-user tax revenues for local roads, streets, and non-highway purposes on the other, will undoubtedly foster this type of financing. However, at present it does not appear likely that all main traveled highways will be included under such authorities.

As long as the financial structure of highway transportation differs from that of privately owned utilities, limitations will be imposed upon the use of utility rate-making procedures and practices in the fixing of rates for highway services.

A particularly important problem in the fixing of motor-vehicle tax rates is the determination of an annual cost. A practical annual cost is the annual expenditure for highways computed by taking the budget for bond interest and redemption, administration, operation, maintenance, betterments, and new construction and subtracting from it funds available from bonds, general taxes, and other non-motor-vehicle sources. Such a cost conforms to the fiscal policy of the state and is particularly desirable in a state which, like Washington, adheres to the pay-as-you-go principle of highway finance.

An annual cost computed in terms of interest on investment, depreciation, maintenance, and operating expense, and otherwise corresponding to the public utility concept, serves several useful purposes in highway transportation administration, but is of limited value in fixing highway-user tax rates.

SUMMARY OF COMMISSION'S ANALYSES

In making highway cost analyses for the State of Washington, the Highway Cost Commission adopted as the annual cost the average annual expenditure from the motor vehicle fund, the fund into which all motor-vehicle license fees and gasoline taxes are paid. The problem was thereby reduced to a proper reapportionment of present collections. (In the future, a more exact budget can be set up by using material gathered by the state-wide planning surveys on required reconstruction, betterments, and new construction.)

Before apportioning the annual cost, the commission sought to distinguish between direct and indirect or joint costs. In the provision of roadway services, no cost is directly attributable to a particular motor vehicle. A hundred vehicles could be removed from the highway without reducing the cost to those remaining. All highway costs are therefore joint costs, and the problem is one of fairly apportioning or allocating the entire annual cost.

The principle underlying the three cost allocations developed by the commission is not new. The advent of heavy motor vehicles carrying loads for which the highways were not designed caused damage and incurred costs which would not have resulted had the loads been within the design limits. Naturally, the concept was early developed that heavy vehicles should defray the cost of increased maintenance resulting from the damage they caused. Later, when highway engineers con-

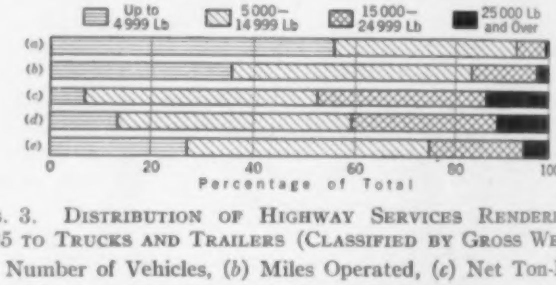


FIG. 3. DISTRIBUTION OF HIGHWAY SERVICES RENDERED IN 1935 TO TRUCKS AND TRAILERS (CLASSIFIED BY GROSS WEIGHT)
(a) Number of Vehicles, (b) Miles Operated, (c) Net Ton-Miles, (d) Licensed Gross Ton-Miles, (e) Gasoline Taxes Paid

structed stronger highways, the logical conclusion was that the heavy vehicles should be charged also with the increased cost of construction. Accordingly, after much controversy, a committee of railroad and highway users, in January 1933, formulated the following principle:

"The basic cost of constructing, improving, and maintaining a given highway should be determined from a highway designed for private passenger vehicles and other vehicles commensurate therewith. All vehicles using such highways should pay their proportionate share of that total as a base tax. The total additional cost of construction, improvements, and maintenance to make a road suitable for a type of vehicle requiring such additional cost should be shared by each vehicle of that type and each vehicle of greater size. Thus, each group should share in the base cost plus all increments of cost up to and including cost required by it." The law under which the commission made its original study agreed substantially with this principle except for the modification that highway-user tax rates should be based upon the "use" of facilities required.

An engineering analysis to determine the facilities required revealed that 15 per cent of the highway con-

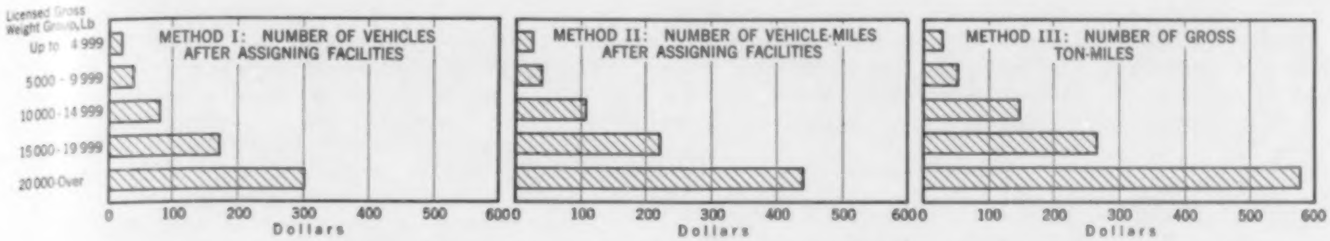


FIG. 4. COMPARISON OF ANNUAL COST PER VEHICLE, BY THREE METHODS OF ALLOCATION

struction expenditure and 10 per cent of the maintenance expenditure were caused by vehicles heavier and wider than private passenger cars. The total of these additional costs was divided among four heavy-vehicle increment groups graduated according to weight and size.

To give consideration to the legislative modification mentioned, an analysis was made not only of the number of vehicles of different weights and sizes, but also of their geographical distribution, annual mileages operated, kind and amount of load carried, and other measures of the highway services rendered them. Typical charts selected from this study are given as Figs. 2 and 3.

The three cost allocations are shown in Fig. 4. The "vehicle-mile after assigning facilities" allocation was one by which the cost of extra facilities required by each increment group was apportioned among all vehicles constituting that and heavier groups in accordance with their use of highways in terms of vehicle-miles. The "number of vehicles after assigning facilities" allocation, prepared for comparison only, differs in that the cost of extra facilities required by each increment group was apportioned equally among the vehicles constituting that and heavier groups. The first method resulted in a greater cost for large vehicles due to its reflection of the greater mileages traveled by them. The "ton-mile" allocation was the one by which the entire cost was apportioned to the different classes of vehicles on the basis of use in terms of ton-miles. The measure of weight incorporated in the unit of use effects an apportionment in accordance with the cost caused without establishing increments of facilities required.

The third method of allocation was made entirely on the basis of use, without establishing increments of facilities required or cost caused by heavy vehicles. The cost was simply allocated in accordance with the gross ton-miles operated by different classes of vehicles.

The average cost for all vehicles weighing over 20,000 lb maximum gross weight was $441 on the basis of vehicle-miles after assigning facilities, and $571 on the basis of gross ton-miles. Interpretation of these cost findings for the purpose of fixing highway-user tax rates necessitates consideration of the limitations surrounding their development and also of intangible factors not subject to precise mathematical ascertainment. The conclusion was that the vehicle-mile finding is an understatement and the ton-mile finding an overstatement, the true cost lying within these practical limits.

When the first schedule of highway-user tax rates based on cost allocations was presented to the legislature, the truckers protested that adoption of the recommended rates would force them off the highway. Not having been instructed to take into consideration the question of the ability of heavy motor vehicles to pay, the commission had no answer for the legislature. Thereupon its instructions were revised to require consideration for "all elements which may properly enter into a determination of fair and proper taxation of each," and brought more into line with transportation utility rate-making theory and practice.

The supplementary analysis included a consideration of value of the service, ability to pay, and other elements warranted by public interest. In this analysis the commission was guided by the statement in the famous Smyth v. Ames railroad rate-making case: ". . . what the public is entitled to demand is that no more be exacted from it for the use of the public highway than the service rendered it is reasonably worth." The first step was to investigate value elements susceptible to mathematical treatment. The basis for this investigation was an analysis of the operating, financial, and tax data taken from the annual reports of 64 passenger and 612 freight motor carrier companies, and from a supplemental questionnaire submitted to them by the commission. (See Fig. 5 for typical freight carrier data.)

A COMPARISON OF RAILWAY AND HIGHWAY COST ITEMS

Since the cost of comparable services in competing industries affects the value of services under consideration, the commission studied the cost of Washington railroad roadway items comparable to highway items. Interest on these items at $4^1/_2$ per cent and maintenance expenses, respectively, amounted to 5.1 and 1.5 mills per net ton-mile during 1935. Motor carriers, on the other hand, paid in state highway user taxes 3.9 mills per net ton-mile and in federal gasoline and other excise taxes 0.9 mill per net ton-mile. This comparison must be qualified, however, by the fact that the railroads' gross revenues were not sufficient to yield the computed $4^1/_2$ per cent.

Determination of the effect of the previously recommended schedule based upon a 0.75 mill per licensed gross ton-mile rate was based upon an analysis of the profitability of motor freight carrier operations. In 1935 they paid 4.07 per cent of their gross revenue in gasoline taxes and 2.41 per cent in license fees. Imposed in lieu of the then existing license fee schedule, the first recommended schedule would have amounted to 4.73 per cent of the gross revenue, an increase of 2.32 per cent. If the fact that a portion of the increased tax would be passed on to the shipper is disregarded, the rate of return on the investment would have been reduced from 6.9 to approximately 3.5 per cent.

These figures are averages for all motor carriers and do not reflect the effect of the tax upon carriers hauling commodities of less than average value operating at low annual mileages. Companies hauling sand and gravel reported average annual mileages per truck of 7,600 and those hauling logs, 9,000. Existing license fees amounting, respectively, to 8.48 and 7.26 per cent of their gross revenue would have been increased to more than 13 per cent under the 0.75 mill rate. A levy in accordance with the metered mileage would reduce the burden on the low-mileage operators but would increase it substantially on the large-mileage operators.

A question which often arises is whether or not motor carriers pay their fair share of taxes for general governmental purposes. The railroads pay in general taxes 10.67 per cent of their gross revenue; water carriers, 3.34 per cent; power companies, 12.28 per cent; and

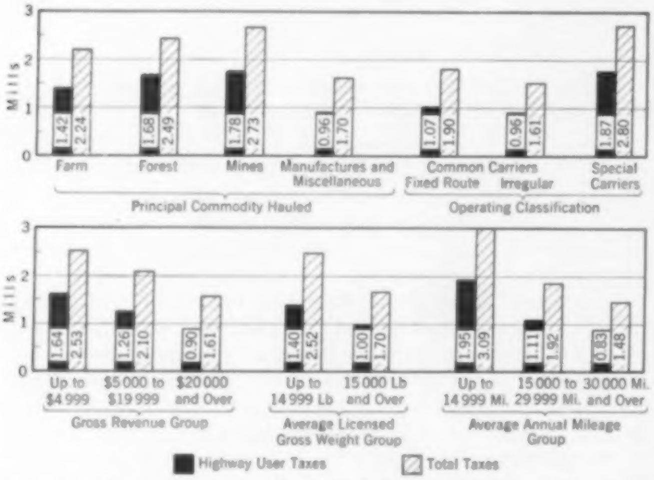


FIG. 5. MOTOR CARRIER (FREIGHT) TAXES PAID, PER LICENSED GROSS TON-MILE, IN 1935

telephone companies, 13.15 per cent. By comparison, motor carriers of passengers and freight pay, respectively, 3.25 and 1.73 per cent. But when regulatory fees and highway-user taxes are added, the respective percentages are increased to 12.08 and 11.14. In terms of percentage of investment, general taxes amounting to 2.01 for freight carriers and 2.16 for passenger carriers compare favorably with the railroads' 0.85, the water carriers' 1.16, the power companies' 1.42, and the telephone companies' 2.59.

SELECTING THE BASES FOR RATES

In determining a fair and proper schedule of highway-user taxes, the bases for levying the rates are as important as the rates themselves. The problem is one of obtaining a balance between two opposing considerations—one, the necessity, from the viewpoint of the various highway users, of developing a schedule of rates which justly reflects all elements properly entering into its determination; the other, the desirability, from the administrative and public viewpoints, of devising a simple and understandable schedule. The trend has been toward a more complicated schedule. This is quite understandable in view of continual revision in response to new conditions, particularly those necessitating increased highway budgets. Though a tax system departs from the ideal from an administrative viewpoint by reason of its complexity, it is not to be discarded lightly. The very features that make it cumbersome usually have been incorporated to make it fair.

In the State of Washington the first tax was a flat fee levied annually upon all motor vehicles. Later it was modified by the establishment of separate schedules for passenger and freight vehicles. When differences in business nature became important, the tax was modified by the imposition of separate schedules for for-hire and private motor vehicles. Several vehicle characteristics have served as bases for highway-user taxation rates, among them horsepower, vehicle weight (net, chassis, capacity, and gross), tire types and sizes, and value determined either by list price or age. Now operating characteristics are becoming popular. Most important is motor fuel consumption as evidenced by the fact that the gasoline tax is now in effect in every state. Mileage taxes of various types are in effect in 22 states. Consideration of the commodity hauled is as yet limited to according special treatment to farm and forest haulers. The locality of operation enters in where vehicles operating exclusively within city limits and contiguous areas are exempted. In several states the gross operating revenue of for-hire operators serves as a basis.

Determination of the elements that may properly enter into the fixing of highway taxation rates, and the development of principles for controlling the relative weight to be accorded to each, can be attempted only after public interest in highway taxation has been defined. The interest of the public generally must have control over the interest of any particular group.

The relationship of highway transportation rate-making to the complicated transportation problem as a whole has already been mentioned. Transportation being such a vital industry, its interest must take precedence over that of any individual transportation agency. This does not mean, however, that a new agency like highway transportation, which has yet to attain its rightful place in serving society, can be stifled. Public interest in the fostering of highway transportation introduces two opposing considerations—one the need of low rates for the encouragement of highway traffic and the other the need of sufficient funds for the construction of an adequate and safe highway system.

Practical legal and administrative or expediency limitations must also receive consideration. When the Washington legislature would not adopt for vehicles weighing over 20,000 lb a recommended metered mileage tax based on rates graduated by weight, annual license fees based upon the average annual mileage of trucks in the respective weight groups were contemplated. Since these would have resulted in undercharges for high-mileage operators and, what is more serious, overcharges for low-mileage operators, annual license fees based upon annual mileages considerably less than the averages for the respective groups were recommended instead.

THE COMMISSION'S SPECIFIC RECOMMENDATIONS

The commission's more important recommendations were that the present tax of 5 cents per gallon on gasoline and the flat registration fee of \$3 on all vehicles be retained; that an additional schedule of maximum gross-weight taxes (\$5 per 1,000 lb over 5,000 and up to 22,000; \$10 per 1,000 lb between 22,000 and 24,000; and \$15 per 1,000 lb over 24,000) be imposed upon trucks; that a 50 per cent higher schedule of taxes be imposed upon trailers; and that a tax of $1^1/_2$ cents per metered mile in lieu of the motor fuel tax be imposed upon dieselized trucks. The truck schedule, graduated in direct proportion to the average annual gross ton-miles operated by each increment group, imposes upon a 34,000-lb maximum weight truck a tax of \$250. The higher rates for trailers were recommended to allow for the fact that they have larger carrying capacities, operate far more miles per year, and utilize much less gasoline than trucks of corresponding maximum gross weight.

Unfortunately, many factors introduce periods of lag between the development of scientific techniques in motor-vehicle taxation rate-making and their adoption. Discouraging as this is, encouragement may be derived from the fact that over a long term, much progress has been made. Future progress, both in the development of scientific techniques and their adoption, demands the accumulation of more and better facts and the formulation of additional principles.

An Organization of Junior Engineers

The "Providence Experiment" Offers Young Men in Rhode Island Many Opportunities for Professional Development

By Alton C. Chick

Assistant Vice-President and Engineer of the Manufacturers Mutual (Group) Fire Insurance Company, and President of the Providence Engineering Society, Providence, R.I.

In his first few years out of college, the young engineer feels the need of some means of bridging the gap between college and business life. In this period he generally has not yet found a place for himself that is well suited to his particular capabilities. He needs an outlet for his energies and ideas which he does not find in his daily work; and he needs some active stimulus to continue his studies, develop his capabilities, and enlarge his social contacts.

An outstanding experiment in providing for these needs was undertaken in Providence in 1935. It resulted in the formation of the Junior Engineering Society of Rhode Island, an organization that is attracting attention throughout the country. Mr. Chick's review of the history and present activities of this group is worthy of serious study. Many of the ideas could be applied to existing junior branches of Local Sections, or in the formation of new ones; and the possibility of cooperation among young engineers in various branches of the profession is of especial interest in communities where there are not enough "civils" to set up a working organization of their own.

The present article is an abridgment, brought up to date, of a paper presented by Mr. Chick at the Eighteenth Annual Industrial Conference held at Pennsylvania State College in May 1938.

Filling the gap between graduation from college and the time when he becomes established in his profession is one of the important problems facing the young engineer. This problem seems to have been recognized by the young engineers and the engineering profession alike, but until recently very little organized action has been taken.

In 1935, the Providence Engineering Society recognized that there was a definite field for activity in promoting the development of the younger men in the engineering profession, and the writer was appointed chairman of a committee to survey the needs and opportunities of carrying out a program to that end. Preliminary investigations were made and a tentative program developed. A list of the junior engineers of Rhode Island was compiled and the first stages of organization were undertaken. Therefore, when General R. I. Rees, representing the Engineers Council for Professional Development, and Frederick M. Feiker, executive secretary of the American Engineering Council, came to Providence early in 1936 and informed us that Providence had been selected, with St. Louis and Cleveland, as a locality where the engineering societies were considered to be so organized that they might well undertake the launching of a program for the development of junior engineers along the lines proposed by the E.C.P.D., we were ready to undertake the task with little or no resistance.

In fact, the Providence Engineering Society was eager to accept the challenge, and appointed a Committee on Junior Engineers' Development to act in an advisory capacity and aid in organizing the Rhode Island junior engineers. This committee revised and brought up to date the list of eligible junior engineers, including in the list those not more than five years out of college. It was decided that membership should not be limited to college men or to members of existing engineering organizations, but should include any young engineer who was interested in obtaining a broader appreciation of his own interests and in participating in a definite program of self development. The names of about 550 men who appeared to be eligible were obtained. We were surprised that there were so many engineers in this category within our territory.

To obtain worth-while and lasting results it was decided to proceed slowly in developing a program. In order to obtain the reactions of the men, and to set up a temporary organization, a small group of twenty-five juniors were invited to meet with our advisory committee. These men were carefully selected for natural leadership through the assistance of representatives of the three engineering schools which contribute the largest number of graduates to this territory—Brown University, Rhode Island State College, and Massachusetts Institute of Technology.

At the first meeting between the advisory committee and this selected group of juniors, we tried to point out in some detail the purposes of the proposed organization, and then gave the juniors an opportunity to state what they might expect from a movement of this kind. It seemed to be the consensus of opinion that personal contacts and self-expression were two of the chief benefits to be derived, rather than material advancement in any particular field.

JUNIORS FORMULATE THEIR OWN PROGRAM

A temporary committee of five juniors was chosen from this group to formulate preliminary plans for the organization. Every effort has been made to have the juniors develop their own organization and formulate their own program to fit their needs as expressed by their own members, under the direction and guidance of the advisory committee, rather than to attempt to force a preconceived program upon them. In this way, they have gained valuable experience in planning for their own welfare.

The next step was to invite all interested junior engineers to attend a mass meeting on April 20, 1936. At this meeting two of the young men summarized the work to date and expressed in their own words just what they considered the junior organization could do for them. General Rees gave a talk on the E.C.P.D., and did much to arouse enthusiasm in undertaking such a program as had been visualized.

A letter and questionnaire were sent to all 550 junior engineers inviting them to join the organization. The questionnaire was prepared to obtain an idea of the interests of the men, as well as a statement as to what sub-

jects each would be interested in for group discussion and formal instruction. Space was provided for each member to state his education, giving the branch of science in which he had specialized in college. These questionnaires provided a wealth of information that was used as a basis for setting up a definite program.

On the basis of this information discussion groups were organized in the following subjects: management; machine design; civil engineering and construction; miscellaneous, including marketing, production, etc.; and power development. Qualified men were chosen from among the members to lead the groups in round-table discussions. Meetings of each group were held at least once each month, and in some cases twice. This type of meeting proved most interesting and beneficial, and is being continued, although the subjects are being varied as special interests develop.

General meetings for the entire membership were scheduled for the first Monday of each month. At these meetings speakers were secured to discuss subjects of interest to all, such as "Adjustments to Be Made by Young Engineers in Their First Few Years of Business," "New Openings Which Juniors May Create," and "Where Do We Go from College?" The speakers were drawn from the leaders of local industries, who were glad to help in this worth-while activity.

An employment file was started which it is hoped will assist members in finding positions best suited to their individual desires and qualifications. Social events were proposed, but it was decided to limit activities during this formative period rather strictly to the professional side.

At the start of the second season, in the fall of 1936, it seemed probable that the momentum which the junior engineers' movement had acquired during the first year would lessen; that when young men were again sought after in business they would no longer feel the same need of common action which the desperation of the depression years inspired.

This was not the case, for the place which an organization of junior engineers can occupy in the development of young men from one to five years out of college, was becoming increasingly well established. The aims of the group through a process of experimentation were becoming clarified, and can be summarized as follows:

1. To afford an opportunity for acquaintance with other young engineers, with leading professional and business men, and with the business and economic life of the community.

2. To provide incentive for study through the medium of group activities.

3. To encourage the practice of clear thinking and self expression.

These aims are not temporary—they are not products of a fad. Neither are they limited to any particular type of individual. Consequently, the junior engineers' movement should always find a place in helping those who are making the transition from college to business. It is essential, however, that a successful system be evolved for maintaining a succession of young men to carry on the activities of the group. This period of need, from one to five years out of college, is a transitory one Each year a new leadership must take over the responsibility.

In order to add new men to the membership it is necessary to know of the young engineers employed each year by industry in a particular locality. At this time there were about 200 enrolled in our junior organization.

To maintain this list for the future a system of personal contacts was set up. A visiting committee of eight or ten members was created to establish contacts with all firms where young engineers are employed. Such contacts have the two-fold purpose of providing new members for the organization, and of acquainting men in responsible positions with the junior engineers' file of members. In a short time this list should be established as the best record of technically trained young men available in the vicinity. It is hoped that employers will make use of it as a source of prospective employees.

Financial arrangements provide that junior members of the Providence Engineering Society and of the local sections of national societies affiliated with the Providence Engineering Society will pay no extra fees for membership in the junior engineers' organization. All others pay a fee of $2 a year to cover operating costs, notices, and other expenses. The members have the use of the rooms and library of the Providence Engineering Society without charge.

The activities of the organization in the second year followed closely the pattern originally set up. Regular monthly meetings of wide general interest were scheduled, with speakers drawn principally from local industrial organizations. Because of the evident interest of business executives in the desire of these young men to improve their capabilities and professional background, it was not difficult to find outstanding men to speak.

Subjects That Interested the Young Engineers

IN order to plan the activities of the group more intelligently, a questionnaire was sent to 550 junior engineers resident in Rhode Island. The replies indicated an almost equal interest in (1) papers by junior engineers, (2) group discussions, and (3) formal study.

Among the 37 subjects put forward for group discussion, 4 drew the votes of 10 per cent or more of those replying. They were:

Production Control and Time Study
Air Conditioning
Personnel
Marketing

Other subjects recommended by at least 5 per cent of those replying were Construction, Machine Design, and Management.

Under the head of formal study, 35 different topics were proposed. Ten per cent or more of those replying favored one of the following:

Business Law
Public Speaking
Cost Accounting
Differential Equation

The only other topic to receive as many as 5 per cent of the votes was Power Plant Subjects.

How the Special Study Groups Are Conducted

Small groups of fifteen to twenty-five men were again arranged for special study, with meetings held once a month, or more often as desired. Chief among the subjects covered by these groups in the second year were machine design, management, and public speaking.

In the machine design group, discussions have been conducted on the basis of mimeographed notes prepared each time by a different presiding chairman. Subjects considered were chosen to coincide with those on which the Machine Shop Section of the Providence Engineering Society had been addressed; so that once a month the group conducted a discussion led by a member, and two weeks later there was a talk by an outside authority on the subject.

The management group covered a wide variety of subjects. Some of their meetings were held as dinner meetings in order to stimulate the social side of the work.

While the management and the machine design groups gave opportunities for organizing thought and self-expression, the third group, on public speaking, was organized mainly for this purpose. Its meetings were held every two weeks, and the members studied books on public speaking and parliamentary procedure. At each meeting several members were selected to give three-minute talks on any subject of interest to them, and after each talk the speaker was given constructive criticism on both arrangement and delivery. There was marked improvement among the men in confidence and in clarity of expression.

PERMANENT ORGANIZATION ESTABLISHED

Near the close of the second year, the juniors decided it was desirable to form a more definite organization. As a result, they established "The Junior Engineering Society of Rhode Island," and adopted by-laws for their future regulation and conduct. They set as their object, "The personal, intellectual, and social development of junior engineers, that they may establish habits of study, of thought, of friendship, and of life."

Just before the season was brought to a close, the Junior Engineering Society made application and was accepted as an affiliate of the Providence Engineering Society, and now functions as such along with the local sections of several of the national engineering societies and other organized technical groups. This close association not only has an inspiring influence on the members, but it makes it possible for the junior organization to publish notices of all its meetings in *Engineerings*, the weekly publication of the senior society, which is sent to members of all affiliated groups.

During the year 1937–1938 the activities of the junior society were continued on much the same plan as before. One new group was organized to study navigation—a subject of much interest in Rhode Island, while another group was set up to study technical German, with special emphasis on the analysis of engineering articles in foreign publications.

The management group was encouraged to undertake a somewhat more extensive program under the leadership of a volunteer adviser. Several accountants were contacted and finally an instructor at Brown University was selected to give a ten-week course in elementary accounting, classes to be held every Thursday evening. The cost of engaging the instructor was divided among the twenty-five members of the group who took the course, and was only a small amount per person. A textbook was purchased by most of the members, and chapters in the book were assigned for home reading. Problems were suggested, but home work was not compulsory and no marks were given.

After completing this study of accounting, the volunteer adviser met with the group and talked on the subjects of standard costs, control through standard costs, budgetary control, corporate organization, and analysis of balance sheets. All these talks were of an informal nature, and after a comparatively short introduction by the speaker, the topic was opened for discussion.

After this series, the group expressed the desire to continue the meetings, having men from various local business and industrial organizations as leaders, and this was arranged. These meetings have offered an excellent opportunity for the members of the group to talk with executives in responsible positions and to benefit by the experiences of older men. The information given by these men, which was mostly of a practical nature, should be of immeasurable value.

SUGGESTIONS FOR FUTURE IMPROVEMENTS

It is planned to continue the discussion groups and to follow approximately the same plan of meetings. The following suggestions which have been made should result in greater benefit to the members in future meetings:

First, the program of subjects and speakers should be planned as far in advance as is feasible in order that the subjects may be presented in a logical order. The advice of some experienced person would be of great value in formulating the program.

Second, greater effort should be placed on the social possibilities of these groups. At present, the group meetings offer practically the only opportunity for the members of the society to become acquainted with one another. Dinner meetings once a month, preceding the group meetings, would offer opportunities for fellowship and mold the groups into stronger units.

Third, the groups should be led by small committees rather than by the chairman as at present. Owing to the relatively few years between graduation from college and the maximum age limit of the society, the turnover of members is high. Because of this, a constant effort must be made to attract new members from the college graduation classes each year. In addition, a new group of younger members must be placed in positions of some authority each year, so that there may be a sufficient number of members trained in the policies of the organization who may be installed as officers. Membership in the small committees governing the groups should be a start toward the training of new members.

More attention is being directed toward development of personality, social activities, and interest in cultural arts. These factors are assuming importance among the qualifications of the engineer of today. The student in college should take this cue, and include in his course the proper amount of cultural studies, and one or more worth-while outside activities.

Likewise, the young engineer should not be content to simply carry out his daily assignments of work, but should make every effort to make new friends and find new fields of interest. He should continually study not only the subjects directly connected with his immediate field of employment, but subjects in other fields of the arts and sciences. In this way he will broaden his horizon, improve his understanding, and make himself a better and more useful engineer and citizen.

With the gradual accumulation of experience, it is becoming increasingly apparent that the junior engineers' movement has a very great value as an outlet through which a young man can expend energy and ideas that are not absorbed in his daily routine work. It is of most value to a man previous to the time when he finds a place in business for which his qualities fit him. It can develop his personality, quicken his intellectual curiosity, strengthen his poise, sharpen his powers of reasoning, and keep alive his ideals. As such a force it has a very definite place in the professional development of young engineers.

Progress in Control of Water Pollution in New York State

By Anselmo F. Dappert

Principal Sanitary Engineer, N. Y. State Department of Health, Albany, N.Y.

In its efforts to abate pollution of surface waters, the New York State Health Department has found it more productive of results to educate public opinion than to resort to legal action, except in extreme cases. That the public is developing greater respect for its natural water resources is clearly shown, says Mr. Dappert, by the large number of sewage treatment plants constructed in recent years. Pollution problems solved in the past and those still requiring solution are set forth in the present article, which is abridged from his paper presented before the Sanitary Engineering Division at the 1938 Fall Meeting.

Activities of the New York State Department of Health are based in general on the state law of 1903. This law gave the Department broad authority to promote improvements in the interest of public health. Specific clauses require that sewerage plans be submitted to the State Commissioner of Health for approval, and that permits be issued by him for the discharge of sewage and other wastes.

Although empowered to issue orders requiring necessary improvements, the Commissioner of Health has in the past avoided using this authority wherever possible. Thus pollution abatement and control have progressed only about as far as public sentiment has permitted. The Department, however, has been active in molding public opinion, and much of the progress made thus far may be attributed to the cooperative, educational, and promotional activities of its engineers. The large number of municipal sewage and wastes treatment plants constructed in recent years is some indication of the increased appreciation which the public has developed for its natural water resources.

Up to ten years ago there occurred in New York State an average of more than three epidemics of typhoid fever a year, attributed to the contamination of municipal water supplies. Since the Olean epidemic of 1928 there has been none, although there have been a few gastroenteritis or "diarrheal" outbreaks which under slightly different circumstances might have developed into typhoid epidemics.

The favorable record in regard to typhoid fever is due partly to improvement in public water supplies, but partly also to the great progress made in the abatement and control of pollution. More than ever before, attention has been directed to the smaller drainage areas tributary to public water supplies with the result that innumerable improvements have been made to provide adequate sewage disposal facilities for schools, institutions, camps, and individual residences. Small in size but large numerically, these improvements are extremely important in protecting public water supplies.

Equally great progress has been made during the past ten years in eliminating untreated sewage and waste discharges from municipalities. Of the total number of municipal sewage treatment plants in operation in the state today, approximately half have been constructed within the last ten years. Excluding New York City, the municipal plants constructed after 1928 are providing treatment for a population about three times as great as that served by all plants constructed prior to that year.

The progress made in pollution control is believed to be almost if not equally as important in reducing typhoid fever as improvements in public water supplies. There never has been a sizable epidemic of typhoid fever or other water-borne disease for which the blame could be placed entirely upon inadequate water treatment. It is therefore important that pollution be controlled—not only the concentrated raw sewage discharges of communities, but promiscuous private outlets and insanitary privies in rural areas.

The importance of adequate control of pollution of surface waters in New York State is emphasized by the fact that more than ten million people are furnished with water from surface sources, the drainage areas tributary to which embrace practically the entire area of the state and parts of several other states.

To illustrate the progress made in the control of pollution in New York State, several parameters may be

Since 1930 About Two Dozen Sewage Treatment Plants to Serve State Institutions Have Been Built in New York
Left: The Plant at Willard State Hospital. Right: The Glass-Covered Imhoff Tanks and Trickling Filters at Great Meadow Prison

employed. The previously mentioned reduction in typhoid fever is one. The changed attitude of the people toward the problem is another. While no particular statistics can be presented that will adequately reflect the growth in public appreciation of clean streams, it must be apparent even to a casual observer that educational measures in public health applied a generation ago are producing results today.

SEWAGE GAS HOLDER, DRY SEAL TYPE, AT WALDEN, N.Y., A TOWN OF ABOUT 5,000 POPULATION

The creation of such agencies as the New York–New Jersey Interstate Sanitation Commission for control and abatement of pollution of the tidal waters of greater New York, and the formulation of the compact for control of pollution in the Delaware River basin, are new developments which emphasize interstate interest in the problem.

Progress is again reflected in the program undertaken by New York State in 1929 of providing sewage-treatment facilities for state institutions. Only one institution remains for which treatment has not been provided.

Increased attention is being given to the necessity of destroying bacterial pollution. Chlorination of sewage effluents is a requirement now commonly applied in the approval of plans for sewage treatment works, and it will be applied with greater frequency in the future. It is not unreasonable to predict that the time will come when all sewage effluents will be disinfected.

TRAINING SEWAGE PLANT OPERATORS

Improvements in plant operation are as important as improvements in plant design. Much is being done in the state to raise the qualification level of sewage plant operators. A recent amendment to the State Sanitary Code prescribes qualifications for them in three different grades and requires new appointments to be made in line with its provisions. It is significant that the Sanitary Code now classifies them as public health personnel and establishes for them, in principle, the same kind of regulations as it does for local health officers and public health nurses. Three-day training schools have been conducted on a regional basis through the state at regular intervals for several years, and have been successful in reaching most of the operators. Advanced courses of two weeks' duration were given early in 1938 by Cornell and New York universities in cooperation with the Municipal Training Institute, the State Department of Health, and a number of other agencies. These two courses provided an opportunity for 30 operators to receive advanced training and to meet one of the qualifying requirements for Grade II operators. The fact that 75 applied for admittance to these courses indicates the interest of the operators themselves.

A more positive attitude is now being taken by the State Commissioner of Health in exercising the authority granted him under the Public Health Law. This may perhaps be regarded as an indication that the program of pollution control is being accelerated. The present laws, which date substantially from 1903, provide a rather cumbersome procedure for enforcement. Several efforts have been made to secure amendments but without success. The cumbersome procedure established by the law has probably been a deterrent to its use, although the policy of the Department has always been to avoid the display of authority as much as possible—so much so that it waited about twenty years before actually instituting formal proceedings against any community to compel the installation of intercepting sewers and treatment facilities. Since 1933 formal proceedings have been taken against five cities. Three of these now have sewage treatment plants in operation and the proceedings against the other two have been temporarily halted in view of their activity toward compliance with the requirements.

The record of construction of municipal sewage treatment plants is a fair index of the progress made in the abatement and control of pollution. Table I shows the number of municipal plants constructed during various periods and the populations served by these plants; and Table II shows the percentages of sewered populations served by treatment works in various years.

TABLE I. MUNICIPAL SEWAGE TREATMENT PLANTS CONSTRUCTED IN NEW YORK STATE IN VARIOUS PERIODS, AND PRESENT POPULATIONS SERVED

Period	Including New York City		Excluding New York City	
	Number of Plants	Present Population Served	Number of Plants	Present Population Served
Up to 1910	29	912,000	24	126,000
1911–1915	29	566,000	29	566,000
1916–1920	19	427,000	18	391,000
1921–1925	26	270,000	23	104,000
1926–1930	50	350,000	48	323,000
1931–1935	32	498,000	32	498,000
1936–1938	45	2,482 000	42	885,000
Totals.......	230	5,505,000	216	2,893,000

In addition to the 230 plants now in operation, a number are being built or planned for early construction. Indications are that about 50 additional municipalities will proceed with construction if they are successful in obtaining federal aid. Forty-five municipal plants have been built during the past three years, and more than 50 industrial waste treatment plants during the past ten years.

There are now 386 cities, villages, and sewer districts having sewer systems, and of these 248 are wholly or in part connected with sewage treatment plants. Only slightly more than a hundred new plants are required, in so far as abatement of existing raw-sewage discharges is concerned, to bring the municipal sewage treatment plant construction program to substantial completion. There are, of course, many communities which do not have sewer systems and which need them to eliminate nuisances caused by overflowing cesspools and individual sewer outlets. To a considerable extent such areas comprise unincorporated areas of towns, where sewer districts must be organized in order to permit financing

TABLE II. PERCENTAGE OF SEWERED POPULATIONS SERVED BY MUNICIPAL SEWAGE TREATMENT PLANTS IN NEW YORK STATE FOR VARIOUS YEARS

Year	Per Cent Including New York City	Per Cent Excluding New York City
1910	5.7	3.7
1915	9.9	14.5
1920	13.3	21.4
1925	18.4	28.6
1930	23.0	38.4
1935	28.0	50.7
1938	49.8	72.3

and construction of the necessary improvements. There are also many small incorporated villages in need of sewer service. At present over 100 sewer districts in the state, representing a population of about a half million, are provided with sewage treatment service either through their own or adjacent plants.

TO TREAT MILK WASTES, THESE HIGH-RATE TRICKLING FILTERS HAVE BEEN INSTALLED AT NUNDA, N.Y.

For many years it has been the consistent policy of the Department to require the installation of treatment facilities at the time new sewer systems are constructed. It may be said, therefore, that the control over future pollution presents no particular problem. The principal difficulties ahead concern cases of long-standing pollution due to discharge of sewage from municipalities which had sewer systems in operation generally before 1903. However, many of these long-standing cases have been solved in recent years through the construction of treatment plants. Buffalo, Niagara Falls, New York City, Albany, Rochester, Syracuse, Auburn, Cooperstown, Corning, Elmira, Geneva, Greenport, Herkimer, Olean, Oneonta, Saranac Lake, Suffern, Watkins Glen, and Wellsville are only a few examples. The rapid progress being made toward solution of New York City's sewage disposal problems is a matter of common knowledge.

In this record of accomplishment, great as the satisfaction may be from a statistical point of view, there is far more satisfaction to be gained by considering some of the flagrant and historic cases of pollution that have been abated. Space however permits a review of but one of these—the case of Buffalo.

For a number of years the State Department of Health had been urging the city of Buffalo to construct intercepting sewers and treatment works to protect the health of the thousands of people in the communities below Buffalo who derived their water supplies from the Niagara River. Several investigations of the pollution of Niagara River between 1909 and 1931 furnished reasons for increasing alarm. But no action was taken.

A WAVE OF POLLUTION IN LAKE ONTARIO

The straw that broke the camel's back was an unprecedented event that took place in 1933. Beginning about March 15 of that year, there was a serious and consecutive failure in the treatment of water in a number of water filtration plants along the Niagara River. A few days later difficulties were encountered in securing adequate chlorine residuals in the treated water at plants between the mouth of Niagara River and Rochester. An explosive epidemic of gastroenteritis or dysentery involving 10,000 cases occurred in one community.

At the time it was scarcely possible to believe that pollution from Buffalo, once reaching Lake Ontario, would pass through the lake in an active and undispersed state. But it soon became apparent that this was occurring—that a slug or "wave" of pollution was actually traveling through the lake and affecting water plants along the southerly shore. It even became possible to predict with fair accuracy the time when the wave of pollution could be expected to appear at a given point.

Two engineers were assigned to locate this wave and collect samples from it. What appeared to be a difficult task proved to be simple. Starting at Oswego and working westward, chlorine-demand tests of the lake water were made at about 5-mile intervals. Within a few hours the wave had been located, its dimensions roughly measured, and samples collected. The results of analyses reflected in general a sewage-water mixture in the proportion of about 1 to 4 or 5. In several cases the chlorine demand of this polluted water was considerably in excess of the amount of chlorine which could be fed by the regular and auxiliary equipment available in the treatment plants.

Subsequent studies and investigations disclosed that the unusual occurrence was due to a peculiar combination of wind and weather conditions and the sudden release, during spring thaws and rains, of pollution accumulated through the winter in Buffalo River and harbor. Subsequently several similar phenomena have occurred although none have extended so far as the so-called "wave" of 1933.

The facts in relation to this occurrence were made the basis of an action begun against the city of Buffalo in 1935, which resulted in the issuance of an order by the State Commissioner of Health countersigned by the Governor and Attorney General, requiring the improvements which have just been completed.

This occurrence demonstrated forcibly that fluctuations in the quality of raw water are as much to be feared as pollution itself. These fluctuations, which are characteristic of polluted streams, occur without warning and make it impossible for water works operators to keep chlorine dosage in line with the requirements for adequate disinfection.

And now a word about the future. For eight years the Department has been engaged in an intensive program to end pollution of the Mohawk and Hudson rivers. A few years ago the communities discharging untreated sewage into these rivers were notified by the State Commissioner of Health that they were expected to have sewage treatment plants in operation by 1940. They were given such notice in ample time to secure the benefits of federal aid. The Department has repeatedly served warnings that it intends to invoke the provision of the Public Health Law against those municipalities that are still discharging untreated sewage by 1940. A great many communities accordingly have taken advantage of federal aid and have constructed the requisite facilities. Many others are anticipating immediate construction if allotment of federal funds can be secured. But there probably will be some cities against which legal proceedings will have to be taken.

At the present time 91 projects for sewerage improvements have been submitted to the PWA and allotment of federal funds requested. These projects represent about $21,000,000 worth of construction. The allotment to date of about $1,750,000 of federal funds will make possible the construction of some 16 of these projects. Federal aid has been the great stimulus for the construction of plants during the last five years and is likely to be a determining factor on the rate of progress in the future.

Roads for Vicksburg National Military Park

Make Available a Picturesque Site Replete with Civil War Interest

By F. W. Cron

Associate Member American Society of Civil Engineers
Assistant Engineer, U. S. Bureau of Public Roads, Hot Springs, Ark.

Historic in American military annals is the siege of Vicksburg during the Civil War. So important and impregnable was the city considered that it seemed to deserve its title of "Gibraltar of the Confederacy." Its fall after 47 days of investment, on July 4, 1863, opened the Mississippi River to the Federal army and effectively severed the Confederacy. The site has been a national military park since 1899. In addition to its romantic features, the problems of access and road maintenance, with details of recent work, are clearly set forth in this interesting account.

Some time after the close of the Civil War, the federal government acquired the sites of the principal battlefields of that great struggle between the states, and converted them into military parks. Today, because of their natural beauty and historical associations, these areas annually attract thousands of visitors from all parts of the country. The provision of adequate highway facilities for these visitors, most of whom travel by automobile, has been a matter of primary concern and in recent years has required the reconstruction and improvement of the older roads to enable them to carry modern traffic. The inadequacy of the older roads has been particularly noticeable in the Vicksburg National Military Park.

This park (Fig. 1), established by Act of Congress in 1899, encloses the city of Vicksburg on three sides, and includes the sites of practically all the breastworks and fortifications used by the combatants. Some of these are still fairly well defined. The reservation, which comprises an area of 1,322.63 acres, is very irregular in shape and in many places contains only enough ground to include the park roadways. In addition, the government exercises jurisdiction over the rights of way of six public roads that were already in the park at the time of its establishment. At points where the fighting was fiercest, the reservation is sufficiently wide to include the Confederate and Union lines and the area between them.

Under the direction of three Park Commissioners appointed by the Secretary of War, the positions of the opposing armies were ascertained; the necessary land to control these positions was purchased; a topographic survey of the area was made; and a road system was planned and executed. Appropriations made by the states and the federal government and donations by individuals and organizations have provided a large number of commemorative busts, portraits, monuments, and markers, some of which are executed on an imposing scale.

U. S. Bureau of Public Roads

Typical Recently Improved Road, Showing Widening at Curve, Rustic Guardrail, and War Monuments

To understand Vicksburg's strategic position on the Mississippi, it is necessary to consult the map, Fig. 1. At the time of the War Between the States, the Mississippi occupied what is now Centennial Lake, making a great bend to the northeast, the eastern limb of which lay against the frowning and heavily fortified loess bluffs of Vicksburg. This bend has since been cut off—a feat which Union troops twice attempted, but unsuccessfully, during their operations in the vicinity. Since all traffic on the river was subject to plunging fire from the river batteries, the passage could be negotiated only by armored vessels; and the stream, for practical purposes, was useless to the Federal troops as long as the town was occupied by the Confederates. Bombardments from river gunboats had no effect whatever on the defenses.

In December 1862, Vicksburg became the objective of a determined campaign which eventually led to its capture. Initial efforts to approach the place overland from Tennessee were frustrated by the destruction of Grant's base at Holly Springs, Miss., and the wrecking of the railroad upon which he had relied for communication. He was then forced to fall back on the Mississippi as a line of supply.

U. S. Bureau of Public Roads

Confederate Avenue Overpass Crosses Hall's Ferry Road Replacing Grade Crossing

Attempts to get at the city from the north, through the Yazoo marshes, were unsuccessful. A second effort to divert the river through a canal below Vicksburg also failed. The persistent Grant then marched his army southward on the Louisiana side, and crossed the Mississippi about thirty miles downstream. In May 1863, he began an audacious operation; with 40,000 men he cut loose from his line of supply and, living off the country,

U. S. Bureau of Public Roads

NEW HEADQUARTERS FOR PARK ADMINISTRATION, ON PEMBERTON AVENUE, VICKSBURG NATIONAL MILITARY PARK

set out to defeat his opponents, Johnston and Pemberton, in detail, before they could effect a junction. In a series of five pitched battles, he defeated the Confederate commanders, driving Pemberton into the defenses of Vicksburg.

Immediately adjacent to the city are two roughly concentric ridges, each highly dissected by ravines, and described by Grant as "admirable for defense." Pemberton had organized the inner ridge defensively in such manner that his lines were about eight miles long, while the investing force took up a 12-mile line on the outer ridge. Two determined Federal assaults on the Vicksburg defenses, made on May 19, were repulsed with fearful slaughter. Grant then reestablished his lines of supply and settled down to siege operations, keeping a wary eye, meanwhile, on Johnston, at his rear. Reinforcements poured in until the Union Army was close to 100,000 men—a force large enough to preclude any possibility of Johnston's raising the siege. Sapping, mining, countermining, bombardment, and such methods of stabilized warfare prevailed for 47 dreary days, until the defenders, almost starved and with ammunition nearly exhausted, surrendered the fortress on July 4, 1863. The favorable psychological effect of the capitulation on the North, coming as it did simultaneously with the victory at Gettysburg, was enormous.

MODERN HIGHWAYS RETRACE OLD EARTHWORKS

Park roadways (Fig. 1), designed to follow the lines of both armies, are intended to make the fortifications readily accessible to the public. Confederate Avenue twists and winds in and out immediately behind the remains of the Confederate works, while Union Avenue lies behind the principal Federal works. Illinois, Wisconsin, Iowa, Sherman, and Grant avenues were built to reach other parts of the Union lines.

Construction work on Confederate Avenue, deemed the most important roadway by the Park Commissioners, was undertaken first. Request for authority to locate this road was approved October 16, 1900. Following the less expensive of two alternate designs, the grading and drainage for the 8.19 miles was completed in 1902 by contract, while the bridges over Glass Bayou, over the Yazoo and Mississippi Valley Railroad, and over Stout's Bayou were finished in 1903. The roads were metaled with gravel in 1905 and 1906 under contract. The surfacing was 18 ft wide and about 7 in. thick. Union Avenue (8.36 miles) was graded and drained and bridges constructed by contract in 1902 and 1903. Gravel surfacing was placed in 1907 and 1908, also by contract.

A notable feature of these roads was the elaborate system of concrete gutters to care for storm waters. But for these gutters the roads would probably long ago have been destroyed in places by erosion. Guttering for Confederate and Union avenues was completed in 1904.

Other park roadways, including circles, were constructed by force account. Of the present 31.86 miles of roads, 30.03 miles were constructed or improved prior to 1910, and all the bridges were built prior to 1908. Building of roads was discontinued in 1913, at which time their total cost, exclusive of bridges and maintenance, was $412,000. The 16 bridges cost $116,000.

U. S. Department of the Interior

ROADWAY BEFORE IMPROVEMENT, LOOKING NORTH ALONG CONFEDERATE AVENUE

Louisiana Memorial, in Distance, Is on Highest Point in the Park

The coming of the automobile, with its higher speeds and accelerated wear on the gravel surfaces, has made most of the roads built by the Commissioners obsolete as to width, alinement and grade, and metaling. In 1931, the War Department let two contracts for paving part of Confederate Avenue and Jackson Road with a plain concrete pavement 18 ft wide and $6^1/_2$ in. thick. These improvements made apparent, by contrast, the necessity for modernizing the remaining park roadways.

Administration of the park was transferred in 1933 from the War Department to the National Park Service

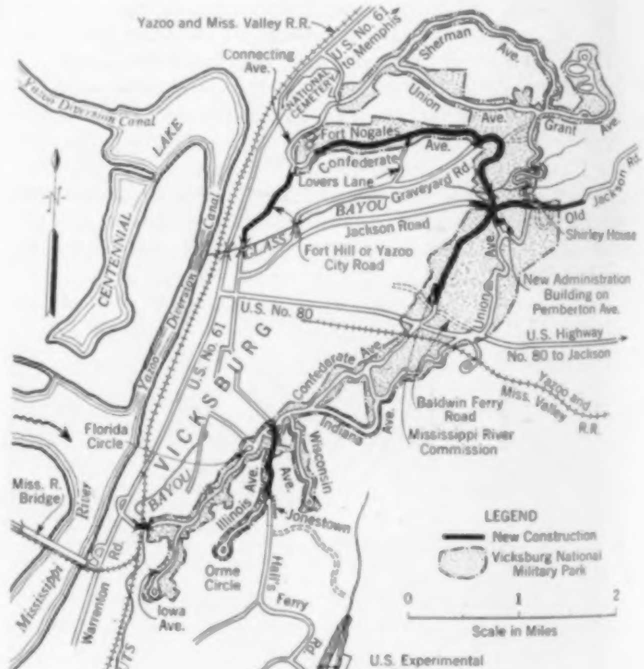


FIG. 1. SKETCH MAP OF VICKSBURG NATIONAL MILITARY PARK, SHOWING ITS RELATION TO CITY, RIVER, AND CIVIL WAR HISTORY

of the Department of the Interior. The Bureau of Public Roads of the Department of Agriculture has been constructing major road projects for that Service since 1926.

A number of factors entering into the design of roads in Vicksburg Park are rarely encountered in ordinary highway construction. Among these are the necessity for preserving the historical remains, while at the same time exhibiting them to the public; the necessity for keeping the construction within the limits of federal ownership, exceedingly restricted in places; and the unusually thorough provisions for control of surface water made necessary by the friability of the loess soil.

The park roadways, originally constructed to disclose the old breastworks to visitors, exist solely because of the prior existence of the fortifications. It is therefore of the utmost importance that new road construction should not involve destruction of historical remains. This restriction frequently results in the introduction of more curvature than would otherwise be desired, and a considerable increase in construction costs.

In some parts, the government owns only sufficient land to accommodate the original narrow carriage roads, with rights of way in places only 30 ft wide. Since no provisions for acquisition of additional land have been made, keeping the improved roads within the park boundaries calls for the exercise of considerable ingenuity.

Pleasing alinement, blending of the roadway with its surroundings, and preservation of the natural beauty of the park are required of all roadways. To achieve these ends, the National Park Service cooperates closely with the Bureau of Public Roads. Preservation of large trees, ordinarily a difficult requirement, is not such an important design factor in this as in other park areas, because few of the trees now in existence have historical

U. S. Department of the Interior

Jackson Road, Looking East Towards the Federal Lines, Before Recent Improvement

View Is from 3d Louisiana Redan, Site of Some of the Fiercest Fighting. Illinois Memorial in the Distance

significance. At the time of the siege, the armies were careful to cut down any trees that obstructed their field of fire.

Vicksburg occupies a dominating position on top of high bluffs composed of a peculiar, fine material known as loess, probably deposited in past ages by winds blowing from the west. About 80 per cent consists of particles smaller than 0.05 mm, and as might be expected from its aeolian origin, it is very uniform in texture. Although easily cut with hand tools, it has the remarkable characteristic of standing unsupported with vertical face for years if protected from running water. On the other hand, it is highly susceptible to erosion, and the streams of the region are continually advancing their

U. S. Department of the Interior

Extreme Left of Confederate Lines, Looking West from Observation Tower

Road Leads to Fort Hill (Old Fort Nogales) Which Overlooked the River, Now Centennial Lake. At This Point the Federal Gunboat *Cincinnati* Was Sunk by Battery Fire. Yazoo River Is Now Diverted and Comes in at Right Center

headwaters into the ridges by means of deep gullies. Some of these are over 50 ft in depth. In places they have advanced to the very edges of the present roads, where they fall away in straight vertical drops of 20 or 30 ft. Erosion control measures undertaken with Civilian Conservation Corps labor have succeeded in halting the advance of the most serious of these gullies. Improvements in road alinement in many cases can be obtained only at the expense of shifting away from the fortifications and into the ravines. Some of the increased cost thus involved should, properly speaking, be considered as expended for erosion control, but must of necessity be included in the highway contracts. It is obvious that an adjacent active erosion imperils the stability of the road.

Special measures must be taken to care for surface water and to construct well-compacted embankments. Past experience has demonstrated the vital necessity of immediately sodding the shoulders, excavation backslopes (except vertical cuts), and embankment slopes. Curiously, vertical banks of loess or banks cut with a slight overhang will stand for years if protected from undermining at the bottom and from the abrasive action of actual streamlets of water. The usual practice, however, has been to excavate on a slope of 1 to 1, or flatter, and then to sod solidly with Bermuda grass.

Rolling of the embankments is always specified. It has been found that, with normal weather conditions, the freshly excavated material contains about the right amount of moisture for maximum compaction. Dry loess will pulverize but not compact at all, while excess moisture creates a rubbery gumbo lacking stability.

Meticulous inspection of grubbing is necessary to ensure that all vegetable matter, even grass and grass roots, is removed before construction of embankments. Sodding must also be carefully supervised, for water finding entrance through cracks in the sod may dissolve large fissures and caverns in the embankments, which, filling with water, may later burst out with disastrous results.

For recreational roads the Bureau of Public Roads requires curves of not less than 150-ft radius where there

U. S. Department of the Interior

EROSION WORK AT THE HEAD OF A RAVINE
Forces of the CCC Restore Original Topography. Above Is the Stockade Redan; at Right the Graveyard Road

is a clear sight distance all around the curve, and a minimum radius of 200 ft where sight is obscured, as by an inside cut slope. Grades are compensated for curvature and are limited to 7 per cent, except short stretches on tangents where 8 per cent may at times be used. Circular curves are superelevated and widened, and have spiral approaches.

Traffic on the park roadways is made up principally of tourists and sightseers and of pleasure drivers from Vicksburg. Driving speeds are limited by regulation to 20 miles an hour. Present design embodies complete control of surface water from the time it falls on the road until it reaches a place where the natural slope is slight enough to preclude gullying. It contemplates a $7^1/_2$ in.-5 in.-$7^1/_2$ in. reinforced concrete pavement, of 22-ft clear width between integral curbs 3 in. high.

NEW WORK EMBRACES SIX PROJECTS

Confederate Avenue today from a traffic standpoint is the most important of the park roadways. Accordingly it has been selected by the National Park Service for priority of improvement. Careful preliminary surveys, begun in 1934, have led to the completion or beginning of six projects for its modernization.

The first of these included not only Confederate Avenue from Baldwin's Ferry Road to Graveyard Road but also that part of Jackson Road which lies within the park boundaries, 3.14 miles in all. Reconstruction involved widening of some curves and relocation of others, while regrading and sodding of most of the slopes were necessary to provide a 5-ft shoulder. Long, buried run-off pipes were substituted for the concrete gutters which had rendered good service for thirty years but which were showing signs of deterioration. The outlet ends of these pipes, invariably located in the bottoms of ravines where the slope was relatively slight, were protected from scour by baffled concrete aprons or velocity-breakers. These structures have functioned remarkably well. Low rustic guardrail, of pleasing appearance, fabricated from locust and cedar logs and stained brown, was installed where needed.

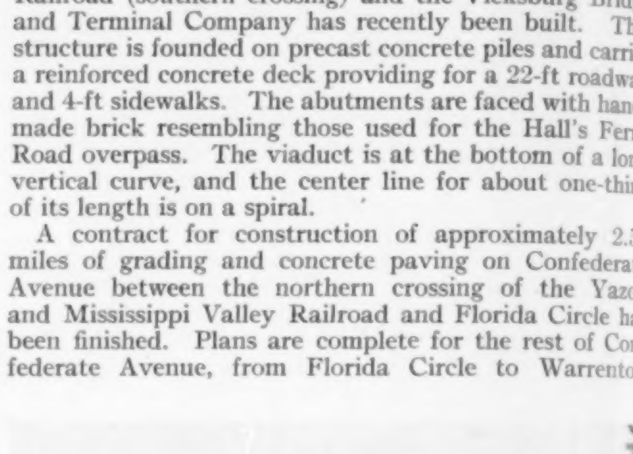
On the 1.93 miles between Graveyard Road and Fort Nogales (an old earthwork dating from Spanish Colonial days) no work other than maintenance had been done since its original construction. This section was regraded to standard alinement and paved with reinforced concrete, of $7^1/_2$ in.-5 in.-$7^1/_2$ in. section. It was poured in two lanes and colored a dark gray by the admixture of emulsified carbon black. Drainage, guardrail, and other features were identical with those on the first project.

It was found that the original steel arch over Glass Bayou could be made to serve by overhauling it and installing a new floor. These repairs, together with similar work on two Union Avenue bridges, were done in 1934.

Improvement of that part of Confederate Avenue lying south of U. S. Highway 80 was begun in the summer of 1936 when a contract was awarded for the construction of a brick-faced concrete arch of 41-ft span over Hall's Ferry Road. Hand-made bricks, resembling in size, color, and texture those found in ante bellum houses in and around Vicksburg, were used for all exposed brickwork, with pleasing effect.

A steel viaduct of eight 58-ft spans across Stout's Bayou and the tracks of the Yazoo and Mississippi Valley Railroad (southern crossing) and the Vicksburg Bridge and Terminal Company has recently been built. This structure is founded on precast concrete piles and carries a reinforced concrete deck providing for a 22-ft roadway and 4-ft sidewalks. The abutments are faced with hand-made brick resembling those used for the Hall's Ferry Road overpass. The viaduct is at the bottom of a long vertical curve, and the center line for about one-third of its length is on a spiral.

A contract for construction of approximately 2.56 miles of grading and concrete paving on Confederate Avenue between the northern crossing of the Yazoo and Mississippi Valley Railroad and Florida Circle has been finished. Plans are complete for the rest of Confederate Avenue, from Florida Circle to Warrenton



U. S. Department of the Interior

FROM FORT HILL, LOOKING NORTH OVER NATIONAL CEMETERY
About 17,500 Federal Soldiers Are Buried in Ground Once Occupied by the Extreme Right of the Union Army, Sherman's Corps

Road, but have not been drawn for the short gap between Baldwin's Ferry Road and the northern crossing of the Yazoo and Mississippi Valley Railroad. Here the difficult problem of passing park traffic through heavily traveled U. S. Highway 80, while at the same time providing a suitable entrance to the park, has not as yet been satisfactorily solved.

Union Avenue, second in importance among the park roadways, presents more difficult location problems than Confederate Avenue. Preliminary studies for its improvement are in progress.

The activities of the U. S. Bureau of Public Roads in Vicksburg National Military Park are under the direction of H. J. Spelman, M. Am. Soc. C.E., district engineer. Until 1936, A. Branson Carpenter, associate highway engineer, was resident engineer in direct charge of the work. Since that date, F. E. Winter, associate highway engineer, has been in charge.

Design of Retaining Wall Footings

Careful Investigation Necessary to Avoid Excessive Bond Stresses

By HARRY E. ECKLES

MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS
ASSISTANT HIGHWAY ENGINEER, STATE DIVISION OF HIGHWAYS, SPRINGFIELD, ILL.

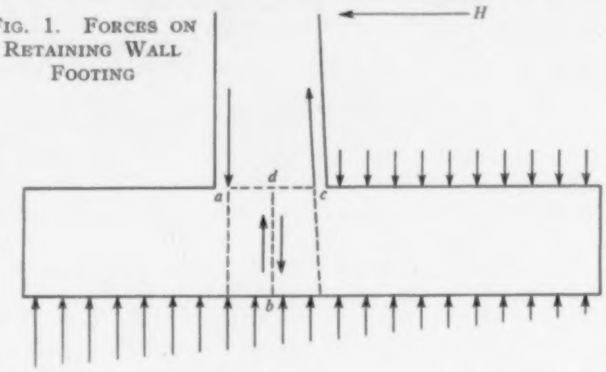
THAT part of wall footings immediately under the vertical wall is the subject more particularly treated herein. It is not accorded consideration in treatises on the subject, and has consequently been neglected by designers. Increasing knowledge of reinforced concrete has resulted in reducing the thickness of both the footing and the shaft of retaining walls, to such an extent that dangerous stresses have unwittingly been introduced in this most critical part of the wall. Walls are sometimes designed with bond stresses at this point several times that allowed by standard specifications.

A correct approach to the problem of design of wall footings is made by considering the stages of construction. Moment in the footing exists only after the wall shaft has been constructed and the fill placed behind it. The forces acting at the top of the footing under the wall shaft are tension in the vertical reinforcement, compression under the front part of the shaft, and shear between the concrete in the shaft and the concrete in the footing which is resisted by friction and cohesion. A construction joint must exist there, and in some cases a key or shear block is used. It is important to notice that diagonal tension does not exist at this plane and that cohesion is destroyed under the rear part of the shaft by moment in the shaft. For these reasons that part of the footing under the shaft cannot properly be considered as an extension of the shaft. Moreover, to consider it thus would be to ignore the existence of a point of contraflexure in the footing, which is a beam at right angles to the shaft.

Horizontal shear in the shaft continues through the footing as shear to the plane of the bottom of the footing. (Since this force is horizontal shear at the top and bottom of the footing, it is hardly logical to regard it as something else between these horizontal planes. For it to be something else would require it to be transformed twice in passing from the top to the bottom of the footing, which again is hardly logical.) It therefore does not act against the horizontal compression in the top of the toe of the footing, which is the result of interaction of the concrete there with the reinforcement in the toe. The heel reinforcement cannot therefore be in tension under the front of the wall shaft. Tension due to moment must react against compression in the opposite side of the footing, in accordance with the fundamental principles of mechanics of beams, and compression does not exist in the bottom of the footing under the front of the wall shaft.

The two primary forces which induce moment in a wall footing are the uplift of the vertical reinforcement at the top of the footing, and the downward pressure of the compression under the front of the wall shaft. The uplift is resisted by the weight of the fill and of the rear part of the footing, and the downward pressure is resisted by the soil pressure under the toe of the footing. A large part of the vertical earth load is transferred to the soil under the toe by vertical shear in the wall shaft. The rear part of the footing hangs, as it were, on the vertical reinforcement, and rotates about it with reference to the wall shaft. The toe of the footing rotates about the centroid of compression under the wall shaft. Reference to Fig. 1 shows that the front and rear segments of the footing rotate in the same direction with respect to the wall shaft.

FIG. 1. FORCES ON RETAINING WALL FOOTING



Tension in the toe reinforcement also is acting in the same direction as earth pressure on the shaft. It is important to notice therefore that tension in the reinforcement of one segment cannot be resisted by any part of the other segment. The moment in the footing near the front and rear faces of the shaft must therefore be balanced by moments in the same segment of the footing under the adjacent part of the wall shaft. These balancing moments come from the short cantilevers, *ab* and *bc*, which exist on each side of the plane of contraflexure, *bd*. Moment is caused by shear acting at the end of these cantilevers at the plane of contraflexure, in the direction shown by the arrows along that plane.

Tension exists in the bottom of the toe of the footing, while compression exists in the bottom of the heel of the footing. These stresses become zero at the vertical plane of contraflexure under the wall shaft. Because stress due to moment cannot pass a plane of contraflexure, bond to develop the full strength of the reinforcement must be provided between the plane of contraflexure and the front of the shaft for toe moment, and between the plane of contraflexure and the rear of the shaft for heel moment.

Reinforcement is embedded in the concrete before stresses are developed therein, and the development of tension in the reinforcement afterwards must also develop tension in the surrounding concrete. It is obviously impossible to develop this tension in the concrete which constitutes the compression side of a footing. It would also be impossible for tension due to moment to pass the plane of contraflexure because all stress there except shear must be zero, to conform to the requirements for every plane of contraflexure. Tension beyond a plane of contraflexure would neutralize compression induced by moment of the opposite sign there, and would destroy the resisting moment in that part of the footing.

The moment of an external force must be resisted by an internal couple, consisting of tension on one side of a

beam and compression on the other side. These internal forces work against each other, with shear existing between them. They must be of opposite sign directly opposite each other in a beam, to form a couple. This would not be true if tension were considered as passing the plane of contraflexure, since tension from the toe reinforcement would then exist in the concrete opposite tension in the heel reinforcement, and tension from the heel reinforcement opposite tension in the toe reinforcement. If bond failure occurs at the toe reinforcement under the shaft, for example, this reinforcement has nothing to pull against in the heel segment, which is rotating in the same direction. Failures of this kind have been known, and have resulted in settlement and tipping of the wall where the foundation material was not soft enough to cause complete failure.

HOOKING DOES NOT PROVIDE EFFECTIVE ANCHORAGE

Hooking the horizontal reinforcement in footings does not provide very effective anchorage, since no tension can be developed beyond the plane of contraflexure. Bending the toe bars into the back of the wall shaft is objectionable for the same reason, and in addition it shortens the length of anchorage of the vertical reinforcement in the footing. Transference of tension from vertical reinforcement in the rear of the shaft to horizontal reinforcement in the toe of the footing cannot take place, because of the direction of the reinforcement through the compression area of the heel segment. Short vertical bars in the rear of the shaft which have square turns at the lower end are most effective for bond in the footing. It is well to remember that bond is not effective on all sides of the horizontal and vertical reinforcement bars near the junction of the shaft and footing, owing to tension existing in the bars and concrete there in directions at right angles to all bars. Economy can sometimes be effected by sloping the top of the footing and by increasing its thickness and the total perimeter of the footing bars to obtain more bond.

It is not necessary to use the ordinary formula for bond for bars under the wall shaft. The effective length of reinforcement in bond is determined by the position of the plane of contraflexure, which can be found by using the following formula:

$$x = \frac{jdM}{M + M_1} \qquad [1]$$

In this equation

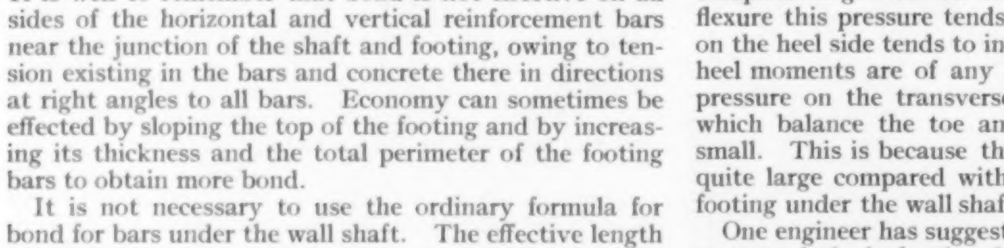
jd = distance from the vertical reinforcement to the centroid of compression of the wall shaft
M = maximum moment in the heel of the footing
M_1 = maximum moment in the toe of the footing
x = distance from the vertical reinforcement to the plane of contraflexure

In deriving this formula the transverse shear, V, in that part of the footing under the wall shaft is considered as constant, and acting as a load at the end of each short cantilever. Also, $ac = jd$ and $cd = x$. The following equations may then be written: $Vx = M$ and $V(jd - x) = M_1$. Dividing the first by the second and reducing gives Eq. 1. It may be observed that this equation shows the plane of contraflexure to be under the middle of the wall shaft when the toe and heel moments are equal. This result is logical, and confirms the accuracy of the method and formulas.

Since the horizontal shear at the top of the footing is parallel to the footing bars, it does not enter directly into a determination of the bond of these bars. The effects of all forces producing this bond are included in the transverse shear V and the moments M and M_1. The horizontal shear at the top of the footing is due to the pressure on the back of the wall shaft, and this effect is included in the toe and heel moments which are used in the formula for finding the bond in the footing bars under the wall shaft.

The shear V could be determined from these moments after finding the value of x, and then be used in the ordinary formula for bond. The method given herein, however, is shorter. The allowable unit bond stress, the perimeter of the bars, and the value found for x, are the three factors to be used in design for developing the full strength of the heel reinforcement. The length to be used for developing the full strength of the toe reinforcement is $jd - x$. In both cases the unit bond stress may be taken as uniform over these lengths of reinforcement. The assumption in the formulas that the transverse shear V is constant is not quite true when the upward pressure on the bottom of the footing is not uniform under the wall shaft, but the resulting errors are small and somewhat compensating. On the toe side of the plane of contraflexure this pressure tends to decrease the shear V, and on the heel side tends to increase it. Where the toe and heel moments are of any magnitude, the effect of this pressure on the transverse shear and on the moments which balance the toe and heel moments is relatively small. This is because the transverse shear V is then quite large compared with the upward pressure on the footing under the wall shaft.

One engineer has suggested in this connection that the reason relatively few bond failures have occurred is that compression exists initially in the reinforcement due to the shrinkage of the concrete in setting, and the final stresses in the reinforcement are therefore substantially less than those used in the design. This can hardly be the answer in the case of wall footings, which have undoubtedly been saved by the use of the customary factor of safety. Flexure in wall footings merely proceeds a little farther to compensate for initial shrinkage stresses. These stresses do not reduce the magnitude of the toe and heel moments, and do not therefore reduce materially the required bond stresses. Resisting moments must be developed under the wall shaft of sufficient magnitude to balance the toe and heel moments. This means that high bond and tension stresses must be developed in the reinforcement approximately in accordance with the designer's calculations, since there is no other source of resisting moment.



CONTRAST OF 100 YEARS

In 1836 the *Raleigh* was put into service on what is now a part of the Seaboard Air Line Railway. A full-scale replica of that engine is shown here alongside a modern passenger locomotive of the same line.

Settlement Studies of Structures

Full-Scale "Control Observations" the Only Reliable Source of Data on Many Important Soil Characteristics

By Gregory P. Tschebotareff, M. Am. Soc. C.E.

Assistant Professor of Civil Engineering, Princeton University, Princeton, N.J.

Development of soil mechanics has provided a better understanding of settlement phenomena. But the most advanced theory and the most refined laboratory technique will not suffice to forecast accurately either the distribution of settlement or the ultimate total settlement of any given structure. The possibility of such accurate forecasts, Professor Tschebotareff suggests, must await the development of a comprehensive program of full-scale "control observations." Towards the end of his paper he tells something of what is already being done along this line. His suggestion that building codes should make these observations compulsory on important new structures is especially worthy of consideration. The present article is abridged from his paper on the program of the Soil Mechanics and Foundations Division at the 1938 Fall Meeting.

Full-scale settlement observations reveal the interrelationship between the type of superstructure and the amount of settlement it can withstand. Further confirmation of known facts concerning the unreliability of small-scale tests is often obtained through such full-scale observations. They form the only really reliable source of information concerning the actual compressibility, the safe bearing values, and other important characteristics of soil deposits in different localities.

In Fig. 1 is shown a reinforced concrete three-hinged arch highway bridge of 235-ft span built in 1929 in Eastern Europe. Borings had been made prior to its construction, but the decomposed peat extracted by ordinary augers was mixed up with clay between which it had been sandwiched so that its true nature was not recognized. Test-piles driven through the sand into the silt drove fairly hard and, according to the dynamic ramming formulas, each could safely carry a load of 14 tons. The whole foundation was then designed accordingly.

This is a typical example of the possible consequences of the indiscriminate use of pile-driving formulas. No consideration was given in this case to the deeper-lying clay layers, and no information concerning them could be obtained from the driving resistance of single piles put down into the overlying sand and silt. Later computations, based on the Boussinesq formulas, showed that compressive stresses exceeding 2 tons per sq ft were created in the clay and peat layers. The resulting compression of these layers caused considerable surface settlements. Figure 1 is to scale. The dotted lines show the position of the bridge as it was built in 1929, and the full lines show its position five years later. The left abutment had settled 1 ft 1 in. at its toe and only 3 in. under its hinge; but the right abutment had settled 6 ft 4 in. at its toe and 3 ft 0 in. under its hinge. The slight outward tilting of the two abutments caused a slight increase of span with a resulting downward movement of the crown hinge of 6 ft 1 in.

This case illustrates well the intimate relation existing between the type of superstructure and the amount of differential settlement that proves harmful to it. It is easy to imagine what would have happened in this case to a two-hinged arch or to a hingeless arch—or to any other type of statically indeterminate superstructure. They most certainly would have collapsed at a fraction of the differential settlement which this three-hinged arch withstood for at least five years.

I do not know the fate of this bridge after 1934. The time-settlement curves available up to that date clearly register the effects of various attempts to improve its condition. Driving sheet piling on the river side of the abutment did not slow down the settlement, as had been hoped by some engineers who thought the movement might be due to lateral and upward yielding of the soil. This slowing down was achieved later by removing part of the embankment fill over the abutment and substituting a light trestle. Time-settlement curves give the life history of a structure and are indispensable for any diagnosis of its actual state that may later be necessary.

Although the case just described is extraordinary, the record for settlement appears to be firmly held by

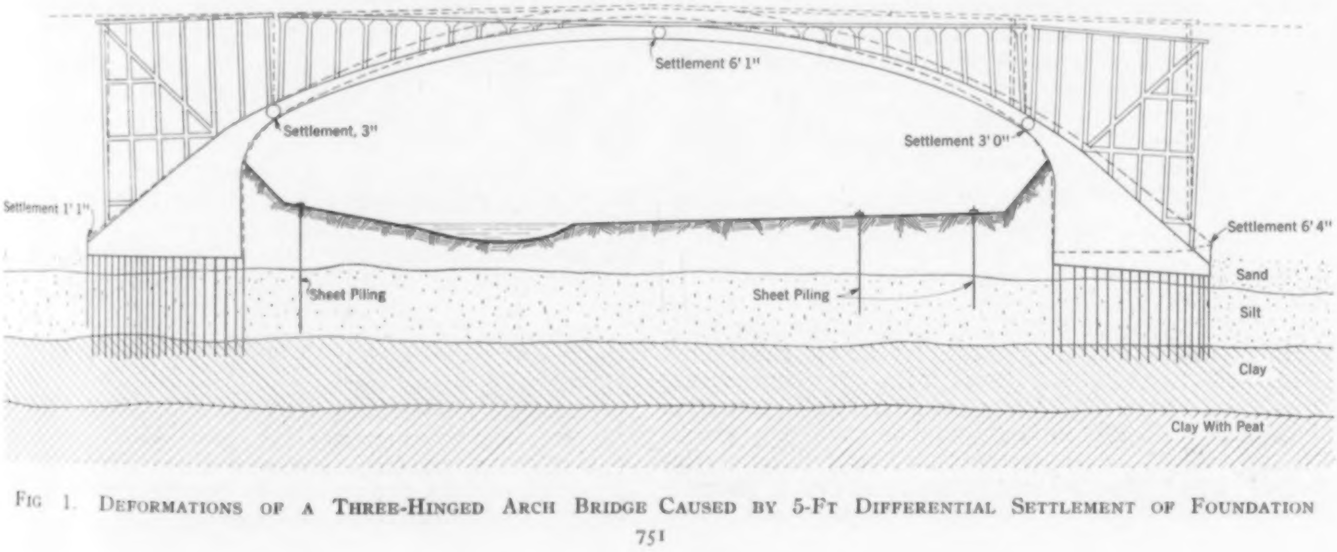


Fig. 1. Deformations of a Three-Hinged Arch Bridge Caused by 5-Ft Differential Settlement of Foundation

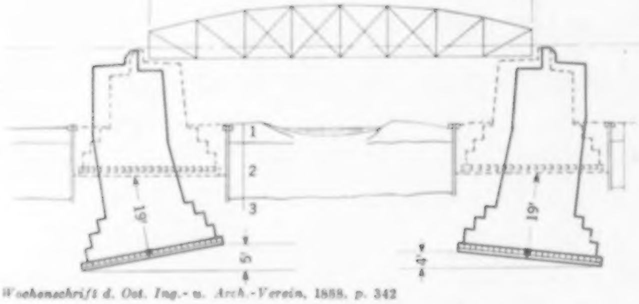


FIG. 2. 19-FT SETTLEMENT OF BRIDGE ABUTMENT
The Piers Were Built Up as Settlement Progressed

a railway bridge erected in 1886 in Central Europe (Fig. 2). The dotted lines in the figure show the original construction in 1886 and the full lines show the shape the piers had assumed after 19 ft of settlement two years later. This shape was a consequence of the jacking up of the bridge girders and of the addition of further layers of masonry to the pier surface. By 1913 the total settlement had reached 23 ft. The trouble here was caused partly by a weak clay layer, but mainly by the presence of numerous small hollow shells in the underlying sand layer. This is another illustration of the fact that statically determinate structures, in this case a freely supported girder, are apt to withstand great settlements without serious and permanent damage.

The next structure to be discussed illustrates the same idea, but in the opposite sense, as it shows how easily buildings of non-uniform height and weight can be damaged by the differential settlements they are likely to provoke.

In Fig. 3 is shown the façade of a monumental public building referred to as Building "T" in my paper in the October 1938 issue of PROCEEDINGS. This building contained a main hall 200 by 50 ft in plan. The foundation consisted of frictional piles imbedded in clay. The congestion of these piles beneath the heavy walls of the main hall was mainly responsible for the greater settlement of these walls as compared with that of the columns, resting on single piles, which supported the central part of the 50-ft wide reinforced concrete floor. The resulting visible curving down of the floor where it was built into these heavy walls caused numerous cracks in its surface. The greater settlement of this hall caused many cracks in the lower walls adjoining it, even though the building was separated into several sections by expansion joints. These joints were ineffective, since they could not be continued through the soil to prevent stresses from spreading. Cracks occurred immediately next to them in the lower walls, which acted as cantilevers over the settlement crater of the hall. Single test piles showed settlements 12 to 20 times smaller than did the heaviest part of the building under the same load per each of the congested piles supporting it.

EFFECT OF STRUCTURAL DETAILS ON CRACK FORMATION

An examination of the façade reveals the effect of some structural details on the formation of cracks. At the top of the drawing in Fig. 3 is shown the deflection of the parapet, as established by optical leveling of the coping. This deflection occurred although the piles beneath the front wall were uniformly loaded. This deflection measured almost 2 in. but did not cause any cracks in the wall above the columns. This wall was reinforced by a heavy continuous reinforced concrete lintel over the columns, that is, in the zone where the wall was stressed in tension due to the deflection. Minor cracks developed in the wall below the columns at the points shown. An interesting point is that these cracks appeared only above the bituminous damp-proof course (Fig. 4), which apparently could not take up horizontal shearing stresses and therefore allowed some sliding along that plane. It separated the lower half of the wall, which was subjected to bending stresses, into two independent beams. The lower one consisted only of a relatively thin and therefore flexible concrete pile capping beam of 16 in. depth, with one layer of rubble masonry above it. For this reason it could easily deflect without damage—especially because it had steel reinforcement along its lower, tensionally stressed surface. The part of the same wall above the damp-proof course was much stiffer. It was about 12 ft high and had no steel reinforcement along its lower, tensionally stressed surface, at the damp-proof course where the cracks developed. Thus the foundation capping was not damaged, but the superstructure above it was cracked because both were designed separately, without consideration for their interaction should any differential settlement occur.

Summing up the results of full-scale settlement studies on ten more structures in Egypt, it is possible to say that they show the great unreliability of the methods of soil investigation previously in current use, such as load tests on small units. At the same time they show that the development of soil mechanics has done much to provide a better understanding of most of the phenomena related to the settlement of structures. This in itself is very important for design practice since it enables engineers to use their sense of judgment on a more rational basis than previously. In a few cases laboratory investigations that permit fairly accurate settlement forecasts are possible. But no real assurance can be had until systematic, full-scale settlement observations on numerous actual new structures have supplied data on the character and peculiarities of local deposits.

THE PRESENT STATUS OF SETTLEMENT PREDICTIONS

When designing a new structure, a knowledge of three things related to the expected settlement is of importance. These three factors are its probable distribution in plan, its final value, and its rate. Can these factors really be accurately forecast by any means at present? I think the answer should be—at least for the first two—"No, this cannot be done with any assurance unless numerous full-scale control observations have been made in the given locality."

As for the first of these factors, the probable distribution of settlement in plan, it follows the laws of stress

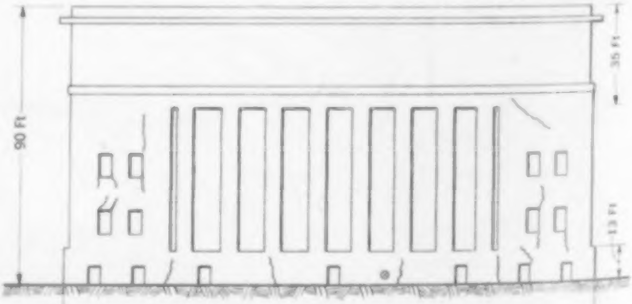


FIG. 3. DIFFERENTIAL SETTLEMENT AND DISTRIBUTION OF CRACKS OVER FAÇADE OF A BUILDING FOUNDED ON PILES EMBEDDED IN CLAY

distribution in the soil when that soil is horizontally homogeneous as regards compressibility. But when is it homogeneous? We know from observations that sometimes it is and sometimes it is not. So far we have no means of ascertaining this in advance in a practical, usable manner.

I understand that recently a new building was erected in Boston in which the foundation and the superstructure were designed as interacting, on the assumption that the soil reactions were distributed over the area of the building according to the laws of stress distribution in a horizontally homogeneous soil. I believe that such assumptions should be avoided in other localities where an insufficient number of full-scale observations has been made to ascertain the character of local deposits. In all doubtful cases, when a safe and economic design is of importance, I believe that the designer should still take into account any possible distribution of soil reactions. An example of such a design is that made by the firm of Moran and Proctor for the Albany Telephone Building, on the basis of a foundation model investigation conducted by Prof. George E. Beggs, M. Am. Soc. C.E., some years ago at Princeton University.

Fig. 4. One of the Cracks at Level of Damp-Proof Course on Façade of Building Shown in Fig. 3

The Damp-Proof Course Is Shown at *A* and the Reinforced-Concrete Pile-Capping Beam at *B*. The Position of This Crack on the Façade Is Marked by a Circled Cross on Fig. 3

The second factor—the final value of the settlements—also cannot be accurately predicted at present because of dislocation and other disturbances to which soil samples are subjected when they are extracted from bore holes. In Cairo we found considerable discrepancies for some stiff clays, for which full-scale observations showed settlements two or three times smaller than those we had forecast. Dr. Charles Terzaghi, M. Am. Soc. C.E., mentions in a recent publication ("Theorie der Setzung von Tonschichten," by Terzaghi-Fröhlich, page 21) cases from his experience in which settlements observed on stiff clays were as much as five times smaller than those predicted. On the other hand, for some weaker clays full agreement was found between the observed and the predicted values—in our work in Egypt as well as elsewhere. Where silts are concerned, it is even more difficult to estimate compressibility at a given depth below the soil surface. Full-scale control observations remain the only reliable means of ascertaining the actual compressibility of local deposits.

The third factor, rate of settlement, can often be forecast fairly accurately by laboratory tests, but in many cases it also requires verification.

COOPERATIVE EFFORT NEEDED TO SECURE OBSERVATIONS

The outstanding practical and scientific importance of full-scale observations on structures has long been recognized and frequently stressed by most leading authorities in the field of soil mechanics and foundation engineering. The Committee on Foundations of the Society's Soil Mechanics and Foundations Division, has considerable difficulty in collecting data on settlements, mainly because very few observations are made. Organized cooperative effort in different localities appears necessary to get such observations carried out.

It is my belief that the Local Sections of the Society might successfully promote such systematic observations. A novel experiment has been made in this respect by the Philadelphia Section, which has formed a special committee for this purpose in cooperation with the Building Inspection of the city and the Philadelphia chapter of the American Institute of Architects. This committee consists of Charles A. Flanagan, Carl de Moll, Emile G. Perrot and Allen R. Wilson, with Prof. Samuel T. Carpenter as secretary, and the writer as chairman. Structures can be obtained for observation only through the voluntary agreement of the owners of the property to such studies. To facilitate their consent, the committee has decided to give a pledge of confidential treatment of all data secured and not to publish results of any investigation without first obtaining the agreement of the property owners. Response has been encouraging and two new structures are already being observed under this arrangement.

Another generally desirable measure for any locality—along the lines of similar proposals by Dr. Terzaghi—is the inclusion in future building codes of clauses making the observation of important new structures compulsory. Such clauses should naturally provide for confidential treatment of data, so that the structures could not be identified by the public at large and no professional or business interests damaged thereby. Otherwise we may still have before us for a long time the present surprising situation—that of building codes continuing to deal at length with pile ramming formulas, load tests, and other investigations that have been proved unreliable in numerous cases; and yet giving no consideration to actual full-scale observations, which are the only reliable means of ascertaining the character of local deposits and of checking code provisions concerning them.

There are some hopeful signs of a changing attitude toward this question. One is the recent formation within the American Standards Association of a Subcommittee on Settlement and Lateral Motion Records of completed structures. This subcommittee is to prepare clauses, for inclusion in a model building code, setting up the requirements and recommended procedure for the full-scale observation of settlement and other movements of new structures. Such observations are to be used for the purpose of checking and developing existing code provisions relating to excavations and foundations. The writer has been appointed chairman of this subcommittee and hopes that its work will pave the way for systematic and standardized observation of new structures in a manner safeguarding all legitimate interests involved.

Samuel Pepys, Slide-Rule Expert

Showing That Famous Diarist Was the Proud Possessor of a Logarithmic "Measuring Ruler" in 1662

By Jerome Fee, Assoc. M. Am. Soc. C.E.

Assistant Engineer, San Francisco Water Department, San Francisco, Calif.

Most engineers have acquired some proficiency in the use of the slide rule, which is peculiarly adapted to the needs of their profession. The engineer may therefore be willing to bestow a glance on a fellow expert who has never received the recognition he deserves.

More than one reader of the famous diary of Samuel Pepys must have asked the question: Was Pepys' slide rule an engineer's rule? Or more precisely, was it logarithmic? The late Florian Cajori asks this question in his *History of the Logarithmic Slide Rule*. He narrowly missed an interesting point in literature and science when he dismissed the subject by saying, "The diary leaves us in doubt." The evidence of the diary is absolutely conclusive, and Cajori is the man who best confirmed it.

"MY RULER TO MEASURE TIMBER"

In the earlier days of the diary, 1662–1664, the subject of rulers is repeatedly mentioned: "Up and my office, there conning my measuring Ruler, which I shall grow a master of in a very little time." Or instead of a measuring ruler, Pepys calls it "my Ruler to measure timber." This measuring of timber was a matter of prime importance, and the reason is not far to seek—vessels in those days were made of timber and Pepys was engaged in no less a task than making the British Navy.

We are apt, however, to misunderstand the expression, "rule for measuring timber." Pepys means by "measuring" not only determining the dimensions, but also computing the cubic contents. Doubtless his slide rule, like many modern ones, could be used for either purpose.

With the aid of his slide rule, Pepys did some remarkable feats of "measuring." Nor does he seem to have been disturbed by the presence of an audience, not even when one of the number was his old rival, Sir William Penn, whose son founded the State of Pennsylvania. "I fell to measuring of some planks that was serving into the yard, which the people took notice of, and the measurer himself was amused at, for I did it much more ready than he, and I believe Sir W. Pen would be glad I could have done less or he more." We doubt if the "measurer himself" was amused. "Amazed," is more likely.

Why is it that Pepys gives almost no indication that his slide rule had other uses besides measuring timber? Or why does he never mention the word "logarithm," which is really the vital point? Non-logarithmic slide rules have been invented, but for reasons which go back to the mathematical theory of functions, their possibilities are comparatively trivial.

On one or two occasions, Pepys goes so far as to say that his rule is for measuring timber "and other things." Beyond this he refuses to commit himself. As far as the word "logarithm" is concerned, this did not come into use until later; Pepys may never have heard it.

The first evidence in Pepys' diary of the true nature of his slide rule is dated March 24, 1662. "Thence Sir J. Minnes and I homewards calling at Browne's, the mathematician in the Minnerys, with a design of buying White's ruler to measure timber with, but could not agree on the price." The next day was the first day of the new year, March 25, 1663. After an account of the day's events, we read: "Thence home and to my office till night, reading over and consulting upon the book and Ruler that I bought this morning of Browne concerning the Lyne of Numbers, in which I find much pleasure."

The "line of numbers" was the Gunter's line—nothing more nor less than a single main scale on the modern slide rule. It was used for some time with a pair of dividers, for multiplying and dividing. Later two scales were combined to form the slide rule. Cajori gives a wealth of information about White's rule in his paper, "On the History of Gunter's Scale and the Slide Rule During the Seventeenth Century." It was inscribed with the line of numbers and was especially adapted "for measuring of Board and Timber, round and square." Even without this valuable data on White's rule, the single reference in the diary to the "Lyne of Numbers" proves that Pepys' rule was, indeed, logarithmic.

In order to fully appreciate Pepys' connection with the slide rule, it is worth while to review the early history of this instrument. The first step leading to its invention was the discovery of logarithms by Napier, in 1614. To our modern eyes, the Line of Numbers, which followed, was a mere obvious plotting of logarithms. We forget that knowledge in those days grew slowly, and that Descartes had not yet made plotting "obvious." Not until 1632—the year before Pepys' birth—was the invention of the slide rule, by Oughtred, announced. Even at the end of the seventeenth century the slide rule was unknown except to a few.

It is significant, therefore, to find that Samuel Pepys was one of the first men to realize the possibilities of this instrument, and to use it practically. Who can fail to share his delight at being master of such a new and powerful device? We easily imagine the enjoyment with which he meets Captain Dean, "and he and I over to Mr. Blackbury's (lumber) yard, and thence to other places, and after that to a drinking house, in all which places I did so practice and improve my measuring of timber, that I can now do it with great ease and perfection, which do please me mightily."

PEPYS MAY HAVE AIDED IN DEVELOPMENT OF SLIDE RULE

It is not a mere superficial pride which Pepys reveals in many such passages. That Pepys had the true scientific spirit is well known, but nowhere is it more clearly displayed than in his relation to the slide rule. It is possible that he aided materially in its development. Who can say more than this: "I have found out some things myself of great dispatch, more than my book teaches me." Later, we find that the special slide rule which he had made to order was "certainly the best and most commodious for carrying in one's pocket, and most useful that ever was made, and myself have the honour of being as it were the inventor of this form of it." Pepys is also credited with the first recorded use of the term "slide rule." He was familiar with the circular slide rule, which was the type first invented by Oughtred. For this information we are indebted to Cajori's writings, without which it might be difficult to understand the cryptic

entry, "Up betimes, and studying of my double horizontal diall."

Pepys' comments on the slide rule end abruptly with his remarks in 1664 concerning a new rule with silver plates. Naturally, as he advanced in power and position, weightier affairs occupied his diary. The slide rule was no longer news. There is reason to suppose, however, that it was not discarded. Thirty years later, Pepys, riding in his coach to Chelsea, was stopped by highwaymen. Although forced to part with his goods and money, Pepys asked one of the robbers to "give him a particular Instrument that was of great use to him." So reads the evidence at the trial which came later, and cost two men their lives.

"Sir," replied the robber, "You are a Gentleman, and so are we; if you will send to the Rummer Tavern at Charing-Cross to Morrow, you shall have it there."

Alas! Pepys did send, and it was not there.

What was the instrument of great value? One may not be certain. But in the list of articles to the loss of which Pepys testified—at the head of the list—was "a Silver Ruler."

ENGINEERS' NOTEBOOK

This department, designed to contain ingenious suggestions and practical data from engineers both young and old, should prove helpful in the solution of many troublesome problems. Reprints of the complete department, 8½ by 11 in., suitable for binding in loose-leaf style, are available each month at 15 cents a copy.

Simplified Analysis of Fixed Beams

By A. Floris

Los Angeles, Calif.

By considering the positive and negative bending moment areas of a fixed beam as loads acting on a freely supported beam of the same span, the condition of fixity implies that the moment area A_0, caused by the external loading, should be equal to the sum of the areas of the fixed end moments M_1 and M_2. In symmetrically loaded beams of constant section, both fixed end moments being equal, it follows that the bending moment area of the freely supported beam divided by its span will give the fixed end moment at either end of the beam.

Inasmuch as the fixed end moments of the unsymmetrically loaded beam, Fig. 1, are not equal, the condition of fixity alone is not sufficient in this case. However, a second condition can be supplied from the expressions of the fixed end moments. By using any one of the well-known methods for the derivation of these moments, it can be shown that

$$\frac{M_2}{M_1} = \frac{c - \frac{l}{3}}{d - \frac{l}{3}} = \frac{s_1}{s_2} \qquad [1]$$

in which c and d are the distances of the center of gravity of the bending moment area A_0 from the left and right supports, respectively.

It is seen, therefore, that the fixed end moments are inversely proportional to the distances between the center of gravity of the bending moment area of the external loading and those of the fixed end moments. This simple result makes it possible to express one of the fixed end moments as a function of the other.

The examples given below will illustrate the application of this method to the analysis of fixed beams.

Example 1. The fixed beam of Fig. 2 is loaded with the concentrated load P at a distance a and b from supports. In this case

$$A_0 = P\frac{ab}{l}\,\frac{l}{2} = P\,\frac{ab}{2}$$

and the center of gravity of this area is at a distance $c = \frac{l}{3} + \frac{a}{3}$ from the left support and $d = \frac{l}{3} + \frac{b}{3}$ from the right support. Hence $s_1 = \frac{a}{3}$ and $s_2 = \frac{b}{3}$, and in accordance with Eq. 1,

$$M_2 = \frac{a}{b} M_1 \qquad [2]$$

Hence $$P\frac{ab}{2} = -M_1\frac{l}{2} - M_1\frac{a}{b}\,\frac{l}{2} = -M_1\frac{l^2}{2b}$$

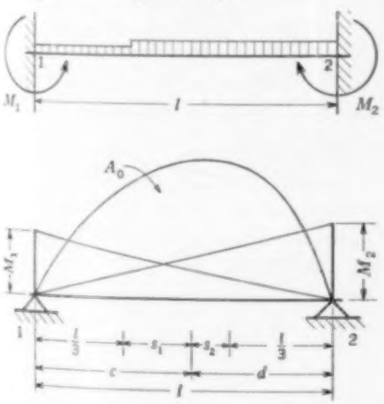


Fig. 1. Moment Areas and Their Centroids

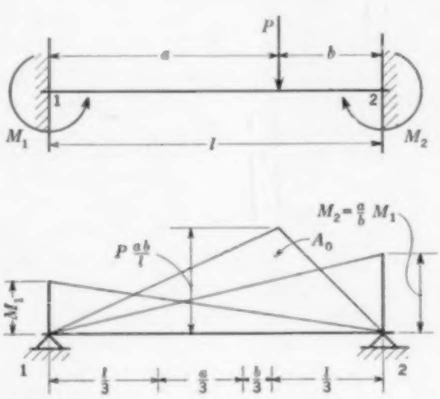


Fig. 2. Concentrated Load

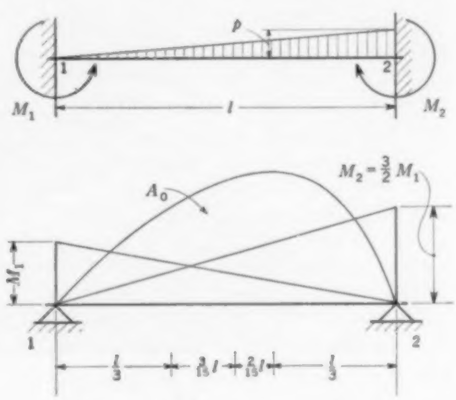


Fig. 3. Triangular Load

or $$M_1 = -P\frac{ab^2}{l^2}$$

and from Eq. 2, $$M_2 = -P\frac{a^2b}{l^2}$$

Example 2. The fixed beam of Fig. 3 is loaded with a triangular load $P = pl/2$. The bending moment area is

$$A_0 = \frac{P}{3}\int_0^l\left(x - \frac{x^3}{l^2}\right)dx = \frac{Pl^2}{12}$$

and its static moment

$$S_0 = \frac{P}{3}\int_0^l\left(x^2 - \frac{x^4}{l^2}\right)dx = \frac{2}{45}Pl^3$$

so that the distances of its center of gravity will be

$$c = \frac{S_0}{A_0} = \frac{8}{15}l, \qquad d = l - \frac{8}{15}l = \frac{7}{15}l$$

Consequently $s_1 = \frac{3}{15}l$, and $s_2 = \frac{2}{15}l$, so that by Eq. 1,

$$M_2 = \frac{3}{2}M_1 \qquad [3]$$

The equality of the moment areas gives

$$\frac{Pl^2}{12} = -M_1\frac{l}{2} - M_1\frac{3}{2}\frac{l}{2} = -M_1\frac{5}{4}l$$

or $$M_1 = -\frac{Pl}{15}$$

and from Eq. 3, $$M_2 = -\frac{Pl}{10}$$

The method described herein is especially useful in beams with complicated loadings. In such cases, after the moment area of the freely supported beam for the given loading has been found, c and d can be determined graphically or analytically by well-known methods.

Determination of a Formula for the 120-Deg V-Notch Weir

By R. A. HERTZLER, JUN. AM. SOC. C.E.

SUPERINTENDENT, COWEETA EXPERIMENTAL FOREST, APPALACHIAN FOREST EXPERIMENT STATION, U. S. FOREST SERVICE

ONE phase of the "forest influences" investigations now being made by the Appalachian Forest Experiment Station is a study of the effect of vegetative cover and land use on stream flow. As basic data for this work, the maximum, minimum, and normal discharges, as well as the total yield, of streams must be determined for drainage areas of known vegetative cover. To obtain these data, various types of stream gaging installations are used. As silt is a minor factor in streams from forested areas located on the old granitic formations of the Southern Appalachian Mountains, a sharp-crested weir equipped with a recorder which produces a continuous stage discharge hydrograph is well adapted for use in this region. From this chart ground-water flow and surface runoff are computed and compiled for further analysis.

The 90-deg V-notch weir is limited to low flows, with high accuracy for the minimum discharge. On the other hand, rectangular and Cipoletti weirs are better adapted to the higher flows, but are not suited to the minimum flows of the streams in these areas. It was therefore necessary for this work that a weir be designed to measure stream flow from zero to 26 cu ft per sec, the minimum and maximum flows estimated from areas ranging in size from 5 to 150 acres, and the 120-deg V-notch weir was found to meet the requirements.

COWEETA EXPERIMENTAL FOREST TESTING STATION
A 90-Deg V-Notch Weir Is Shown in Tandem with a Suppressed Rectangular Weir

A comparison of the formula for the 120-deg V-notch weir, as determined here, with formulas for the 90-deg V-notch and rectangular weirs shows that for a 2-ft head the capacity of the 120-deg blade is 1.73 times that of the 90-deg blade and slightly greater than the capacity of a 2.6-ft rectangular blade. The adopted design is shown in Fig. 1.

Previous tests conducted with 120-deg V-notch weirs by Cone, Gourley and Crimp, Tarrant, Greve, and

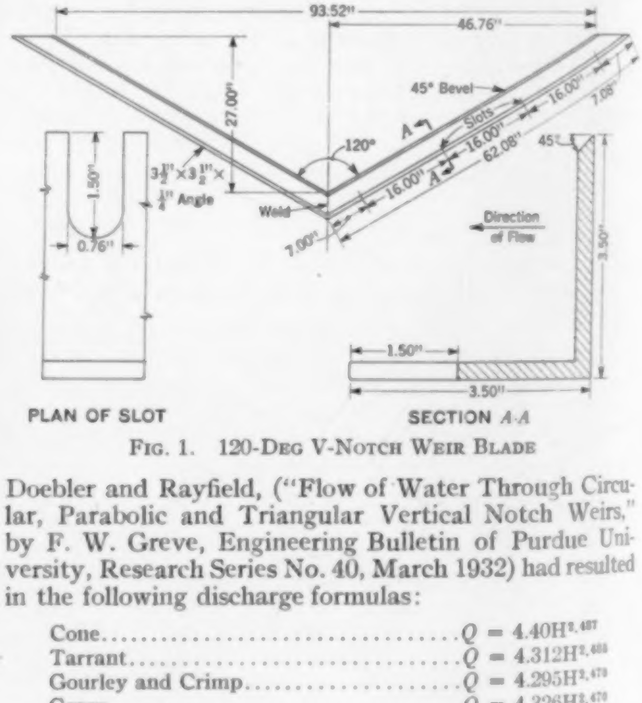


FIG. 1. 120-DEG V-NOTCH WEIR BLADE

Doebler and Rayfield, ("Flow of Water Through Circular, Parabolic and Triangular Vertical Notch Weirs," by F. W. Greve, Engineering Bulletin of Purdue University, Research Series No. 40, March 1932) had resulted in the following discharge formulas:

Cone	$Q = 4.40H^{2.487}$
Tarrant	$Q = 4.312H^{2.488}$
Gourley and Crimp	$Q = 4.295H^{2.470}$
Greve	$Q = 4.326H^{2.470}$
Doebler and Rayfield	$Q = 4.38H^{2.500}$

However, these formulas were not derived for the condi-

tions under which several of our installations were operating. Accordingly, calibration tests of a specially designed blade were made in the field hydraulics laboratory of the Coweeta Experimental Forest, near Franklin, N.C., by comparison with discharges from a 3.95-ft suppressed rectangular weir of known discharge formula.

Both weirs were made of structural steel angles, fabricated to within $^1/_{32}$ in., beveled at 45 deg to a sharp edge at the upstream face, painted, and bolted to wooden frames in the control channel. The channel was constructed of surfaced lumber which afforded a minimum frictional resistance.

The stilling basin for the triangular weir was large enough to obtain a minimum side contraction of 2.5 times the head, with a bottom contraction of 2.5 ft. The influent to the stilling basin or weir box, in tandem with the rectangular weir, was baffled with 1-in. by 6-in. adjustable boards in addition to a "wave reducer" consisting of a festoon of floating logs. Air was supplied to the nappe of the suppressed rectangular weir through holes drilled in the side of the channel. Heads over both weirs were measured in wooden stilling wells equipped with hook gages reading to 0.001 ft.

A total of 103 test runs were conducted with free-flow conditions over both weirs. Discharges greater than 0.5 cu ft per sec were determined from the observed head over the rectangular weir. After the flow was regulated through the field laboratory channel by a control gate, steady flow conditions were indicated by five consecutive similar hook gage readings, taken at 5-minute intervals at both weirs. Discharge measurements less than 0.5 cu ft per sec were taken by weight.

As a result of these tests, the following formula was derived for the 120-deg V-notch weir, for discharges greater than 0.2 cu ft per sec:

$$Q = 4.43H^{2.449}$$

where Q is the discharge in cubic feet per second, and H is the observed head measured 6 ft upstream from the blade. This formula indicates a slightly higher discharge than do those of previous experimenters, whose work was done in channels of limited depth or width.

Our Readers Say—

In Comment on Papers, Society Affairs, and Related Professional Interests

Formulas for Deflections of Cantilevers

DEAR SIR: Equations 1, 2, and 3, presented by R. Reuben Kohn in his article in the July issue, give reliable results when the cantilever is divided into equal lengths, and when that condition exists the formulas would have to be classed as special formulas. For a concentrated load at the end of a cantilever and with the moment of inertia changing along its length, it seems to me that the algebraic moment-area method is as general as any, and the results can be obtained in a very short time. Using the values given by Mr. Kohn with 360 lb applied at the end, I get a deflection of 36.8 in. by the algebraic moment-area method.

For a cantilever with a uniform load applied along its length and having the moment of inertia changing along its length the deflection can be solved by the slope-deflection method, which can be classed as a general method.

Using the author's example with a wind load of 27 lb per sq ft on the projected area of the cantilever, the moments can be calculated due to cantilever action at the various joints where the moment of inertia changes in value. In the accompanying Fig. 1 these moments are indicated in parentheses.

Now assume a hinged support (which is not there) at each joint where the moment of inertia changes in value and then calculate the fixed-end moments due to the uniform loads at the various joints. These moments are indicated in Fig. 1 in brackets. At the end where the cantilever is fixed the angle of rotation, θ_1, is zero, and applying the slope-deflection equation for the first section

$$-1{,}030{,}000 = 2E(2.716)\,(0 + \theta_2 - 3R_1) - 9{,}464 \quad \ldots\ldots [1]$$

$$\text{From Eq. 1, } E\theta_2 = -187{,}900 + 3ER_1 \quad \ldots\ldots [2]$$

$$\text{Also, } +649{,}000 = 2E(2.716)\,(-375{,}800 + 6R_1 + 0 - 3R_1) + 9{,}464 \quad \ldots\ldots [3]$$

From Eq. 3, $3ER_1 = 493{,}600$; thus from Eq. 2, $E\theta_2 = 305{,}700$.

Repeating this operation until the end of the cantilever is reached, all the θ's and R's can be solved. Their values are shown in Fig. 1.

Adding all the R's we get $\dfrac{5{,}020{,}900}{E}$, and as each length represents 208 in. the deflection at the end of the cantilever will be $\dfrac{5{,}020{,}900 \times 208}{29{,}000{,}000} = 36.01$ in. The author with his assumed condition gets 38.8 in., which he states to be a trifle large.

By means of the slope-deflection method the displacement at any joint can readily be solved. From Fig. 1 the displacement of the joint between the 14- and 12-in. pipe is $R_1 \times 208 = \dfrac{164{,}500 \times 208}{29{,}000{,}000} = 1.18$ in., and the displacement of the joint between the 12- and 10-in. pipe is $208(R_1 + R_2) = 3.37$ in.

When the cantilever under consideration is divided into equal lengths, Mr. Kohn's method will give results that are a trifle large, and the displacement can be solved in a very short time. If the lengths are not equal then his three special equations cannot be used. On the other hand, by using the slope-deflection method

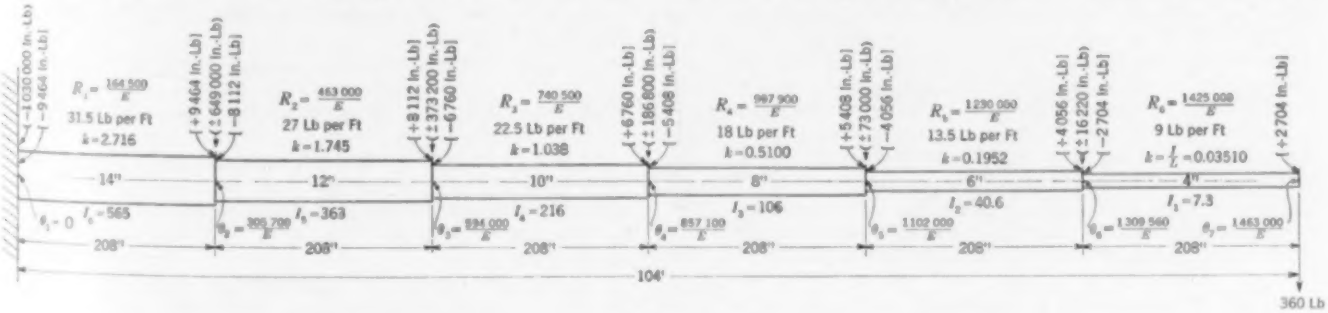


FIG. 1.

the displacement can be solved even if the cantilever is not divided into equal lengths; moreover, the concentrated load at the end can be combined with the uniform load and the displacement calculated in one operation.

A. W. FISCHER
Associate Structural Engineer
Construction Service
Veterans Administration

Washington, D.C.

Flag Pole Deflection

TO THE EDITOR: In his article entitled "General Formulas for Deflections of Cantilevers" in the July issue R. Reuben Kohn's solution is approximate and limited to pole segments of equal lengths. Also, the application of the area-moment method to cantilever beams presents a case for which the method is least suited.

The following general solution applies Mohr's Work Equation. Similar and more difficult problems are treated in the writer's "Structural Engineering Problems," pages 45 and 49, as applied to building frames. The diagrams (Fig. 1) and the following general formulas illustrate the solution for deflection of a cantilever beam, and can easily be followed without any detailed description. Note that the units chosen are kips for loads and feet for lengths, with $E = 144 \times 30{,}000 = 4{,}320{,}000$ kips per sq ft. The values of $1/I$ are given in feet^{-4}.

$$\text{Top section:}\quad \Delta_1 = \frac{1}{EI_1}\int_0^{l_1} Mm\,dx = \frac{l_1 M_1 m_1}{3EI_1} =$$

$$\frac{17.33 \times 2{,}840}{3 \times 4{,}320{,}000} \times 7.31 \times 17.333 = 0.483 \text{ ft}$$

$$\text{2d section:}\quad \Delta_2 = \frac{1}{EI_2}\int_0^{l_2} Mm\,dx =$$

$$\frac{l_2}{6EI_2}\left[M_1(2m_1 + m_2) + M_2(m_1 + 2m_2)\right] = 0.723$$

$$\text{3d section:}\quad \Delta_3 = \frac{1}{EI_3}\int_0^{l_3} Mm\,dx =$$

$$\frac{l_3}{6EI_3}\left[M_2(2m_2 + m_3) + M_3(m_2 + 2m_3)\right] = 0.917$$

$$\text{4th section:}\quad \Delta_4 = \frac{1}{EI_4}\int_0^{l_4} Mm\,dx =$$

$$\frac{l_4}{6EI_4}\left[M_3(2m_3 + m_4) + M_4(m_3 + 2m_4)\right] = 1.068$$

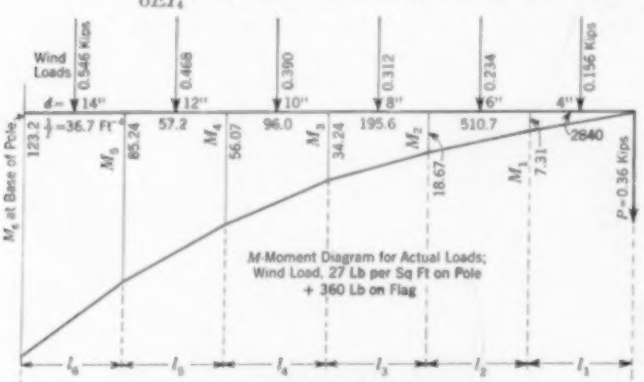


FIG. 1.

$$\text{5th section:}\quad \Delta_5 = \frac{1}{EI_5}\int_0^{l_5} Mm\,dx =$$

$$\frac{l_5}{6EI_5}\left[M_4(2m_4 + m_5) + M_5(m_4 + 2m_5)\right] = 1.268$$

$$\text{6th section:}\quad \Delta_6 = \frac{1}{EI_6}\int_0^{l_6} Mm\,dx =$$

$$\frac{l_6}{6EI_6}\left[M_5(2m_5 + m_6) + M_6(m_5 + 2m_6)\right] = 1.471$$

$$\text{Total } \Delta = \Sigma_1^6 \Delta \qquad = 5.930 \text{ ft}$$

When all the sections have the same length l, then $m_1 = l$, $m_2 = 2l$, $m_3 = 3l$, etc., and

$$\Delta = \frac{l^2}{6E}\left[\frac{2M_1}{I_1} + \frac{4M_1 + 5M_2}{I_2} + \frac{7M_2 + 8M_3}{I_3} + \frac{10M_3 + 11M_4}{I_4} + \frac{13M_4 + 14M_5}{I_5} + \frac{16M_5 + 17M_6}{I_6}\right] = 5.93$$

The deflection at any joint is equal to the $\Sigma\Delta$ from the top of the pole down to the joint in question. Thus, the top deflects 0.483 ft for the topmost section, and $0.483 + 0.723 = 1.206$ ft for the two top sections, or for a pole 34.67 ft high.

The only approximation is in drawing the M-moment diagram as a polygon instead of a smooth curve of slightly lesser area. Hence the deflection 5.93 ft = 71.16 in. is on the large side. No allowance was made for the stiff socket connections between the segments.

DAVID A. MOLITOR, M. Am. Soc. C.E.

Harlingen, Tex.

Square Root Calculated by Machine

DEAR SIR: The article by George H. Dell on "Calculation of Square Root by Successive Approximations," in the September issue, should be of interest to computers. The use of the slide rule for this purpose is helpful indeed. However, if a computing machine is available, the exact square root of any number within the capacity of the machine can be obtained.

Although the method is based on the longhand extraction of the square root, the operation is purely mechanical. Hence, to obtain the square root of a given number, set the number in the machine, with the carriage moved to the extreme right. Clear the given number from the keyboard, and the number "one" from the carriage. If the number contains an odd number of integers, begin subtracting successively from the given number (without moving the carriage from its original position) the numbers 1, 3, 5, etc., in the first column on the left side of the keyboard until the bell rings, or until a series of "9's" appear on the left end of the remainder. If, say, 5 was the last number subtracted, add it again, shift the carriage one decimal place to the left and press down the next lower number—in this case 4. Repeat the operation, now using the next column to the right. When the carriage has finally moved to the extreme left, the answer appears in red on the carriage, and the remainder is on the machine proper. If the number has an even number of integers, the successive subtraction is begun in the second column from the left.

A similar method can also be used to extract the cube root of a number, but that involves some mental calisthenics, and in this case the longhand method is preferable.

ANTONIO DI LORENZO, Jun. Am. Soc. C.E.

West New York, N.J.

More About John Findley Wallace

DEAR SIR: I was glad to read the life of John Findley Wallace, thirtieth President of the Society, in the September issue. He once told me that he made a rule always to spend one half of his income—so whenever he got a better job he told his wife how much more they had to spend.

I never heard anyone else make that statement.

T. KENNARD THOMSON, M. Am. Soc. C.E.
Consulting Engineer

New York, N.Y.

Need for Further Study on Fatigue Tests of Riveted Joints

To the Editor: The results which Professor Wilson has published in his article on "Fatigue Tests of Riveted Joints," in the August issue, are sufficiently consistent among themselves and with the foreign work to justify immediate study by engineers concerned with the specifications for riveted bridges. For instance, the low values shown by structural silicon steel are startling. We must not jump to the conclusion that we have used silicon steel too freely, or that our silicon steel bridges will be unduly short of life. Such a conclusion would be entirely unwarranted.

It is suggested that study now be given such leading questions as the following:

1. Most of the data is based upon failure at 2,000,000 cycles of stress. How many bridges or bridge parts, and what types of bridges, may reasonably be expected to receive that many repetitions of maximum stress?
2. Is some far smaller number of repetitions an adequate estimate in the case of certain bridges or bridge parts, and should specifications recognize such a difference by permitting in them a higher unit stress?
3. Should fatigue be recognized in fixing the unit stress for pulsating stresses of one sign (as is not done now), as well as in cases of reversal?
4. Is the effect of reversal upon main material as severe as present specifications imply?
5. If fatigue failure is the failure of the plate material in the splice or joint, is not our present specification for rivet unit stress in cases of reversal far too severe?
6. Should lower factor-of-safety percentages be used in respect to fatigue failure from that used for static failure?
7. What limitations are to be put upon silicon steel, in members in which fatigue may need to be taken into account?
8. Can any steel be made available, at the cost of silicon steel, which will have all its static strength and more strength in fatigue after fabrication? (This question is for the metallurgists.)

It may be of interest to note what the effect upon the specifications for bridge design has been in Germany, where this type of test was originated.

1. For riveted highway bridges fatigue is overlooked; a single unit stress is applied to the maximum total stress, regardless of the minimum.
2. For riveted railway bridges of carbon steel, no account is taken of fatigue when there is no reversal (as in American practice). In case of reversal the unit stresses are reduced, the reduction being the same for the rivets as for the material. The reduction is less severe than in this country, and is obtained by adding three-tenths of the minimum stress to the maximum, instead of five-tenths.
3. For riveted railway bridges of high-tensile steel, the reduction for fatigue effect is more drastic than for carbon steel. It affects members with stress of one sign, if the minimum is less than 22 per cent of the maximum. As the ratio of minimum to maximum decreases, the rate of decrease of allowable unit stress is greater than for carbon steel. For static or near-static stresses, in tension members, the allowable unit stress on high-tensile steel is 50 per cent higher than on carbon steel; for minimum stress equal to zero, the superiority of high-tensile steel is reckoned at 30 per cent; at full reversal the two steels are accorded exactly equal value. This is drastically different from our practice, in theory; but it does not affect many members in a bridge of simple span. For compression members, and for bridges with infrequent traffic, the German specification is less severe than just stated.
4. For welded bridges the German specification is extremely complex. It again penalizes high-tensile as compared with carbon steel when the range between minimum and maximum is great, and it ascribes different degrees of penalty to different types of weld. Something of the same sort, but in far simpler form for application, is found in the bridge specification of the American Welding Society.
5. The factor-of-safety percentage is not nearly so high for the more improbable cases of fatigue failure, as for static failure.

The topic has just been opened in this country by the Welding Society's bridge specification and by Professor Wilson's paper, and is deserving of close study and further experimentation, as it has a definite bearing upon the life of bridge work.

Jonathan Jones, M. Am. Soc. C.E.
Chief Engineer, Fabricated Steel Construction, Bethlehem Steel Company

Bethlehem, Pa.

More About Desmond FitzGerald, Early President

To the Editor: The brief biography of Desmond FitzGerald in the August issue appears to have omitted reference to some of the important events in his career. Having served as his personal assistant on the Boston Water Works from 1895 to 1898 and on the Metropolitan Water Works from 1898 to 1902, I have vivid recollections not only of events during that period but of the descriptions of earlier work which he gave me from time to time.

Mr. FitzGerald's first work on the Boston Water Works was as superintendent of the Western Division, as has been stated. The biography does not indicate how this position was expanded during his tenure. Starting with the Brookline and Chestnut Hill reservoirs near Boston, Lake Cochituate, and the Cochituate Aqueduct, the supply was increased by the addition of the Sudbury Works (including at that time the Sudbury Aqueduct and Reservoirs 1, 2, and 3 in Framingham), which were put in service in 1878. The extent of the works under Mr. FitzGerald was more than doubled by this accession. A few years later, he was made resident engineer of additional supply under the city engineer, having charge of the construction of the Ashland and Hopkinton reservoirs on the Sudbury drainage area and the beginning of the construction of the Sudbury Reservoir. The Metropolitan Water Board commenced operations in 1895, taking over from the city of Boston the unfinished Sudbury Reservoir and completing it. Mr. FitzGerald divided his time between the Metropolitan Water Works as engineer of the Sudbury Department and the Boston Water Works as superintendent of the Western Division. In 1898 his connection with the Boston works came to an end.

Early in Mr. FitzGerald's career he became intensely interested in the relations between rainfall, flow of streams, and storage. He also investigated the dependability of rain gages of various types and with different kinds of exposure, and started one of the longest continuous records of a recording rain gage in this country. He designed and built an elaborate recording rain gage, located at Chestnut Hill Reservoir, which together with records of the first few years of its use, was described by him in Vol. 21 of Transactions. Noting the discrepancies between records of various rain gages differently located, he had a series of towers built up to a maximum height of 60 ft and nine rain gages located on them far enough apart so there would be no mutual interference. Daily observations were taken for three years, and the results reported in the *Journal of the Association of Engineering Societies*, Vol. 3.

In 1887 he made a report to the City Engineer of Boston upon "The Capacity of the Sudbury River and Lake Cochituate Watersheds in Time of Drought," and this report was reprinted in the Journal of the New England Water Works Association for December 1887. This was one of the earliest scientific reports upon a dependable supply of water from a surface source.

Under both the Metropolitan Water Board and the Boston Water Department, Mr. FitzGerald was permitted to accept outside work as an expert. Sometimes I was relieved from my regular work to assist him in a special case. I recall his work in connection with the determination of the value of the Newburyport Water Works. I spent several days making somewhat crude determinations of the frictional loss in 4 and 6-in. cast iron and cement water pipes. The losses of head were measured by pressure gages, and the rate of discharge was determined by noting the time required to fill a watering cart and then driving the cart upon platform scales. This appears to be one of the first cases, if not absolutely the first, in which a water works expert took into account the frictional losses in water pipes, in finding a value for the plant.

Charles W. Sherman, M. Am. Soc. C.E.
Consulting Engineer

Boston, Mass.

Desmond FitzGerald—Artist

TO THE EDITOR: I was much interested in the life of Desmond FitzGerald, twenty-ninth President of the Society, which appeared in the August issue of CIVIL ENGINEERING. In that article particular attention was paid to Mr. FitzGerald's love of art and to the fact that he had some ability as an amateur artist himself.

The accompanying photograph is of Simeon Borden, one of the early presidents of the Boston Society of Civil Engineers. This photograph is of a crayon drawing made by Desmond FitzGerald,

SIMEON BORDEN
From a Crayon Drawing Made by Desmond FitzGerald

which he presented to the Society about fifty years ago. I ran across this portrait two or three years ago when I was preparing the professional memoirs of the thirty-three founder members of the Boston Society of Civil Engineers. This article was published in the July 1936 issue of the *Boston Society of Civil Engineers Journal.*

J. B. BABCOCK, M. Am. Soc. C.E.
Professor of Railway Engineering
Massachusetts Institute of Technology

Cambridge, Mass.

Sewerage Problems and Their Solution at Miami Beach, Fla.

TO THE EDITOR: A resort city such as Miami Beach, situated on an island about one mile wide and nine miles long, having an average ground elevation of about 5 ft above mean low water, presents some interesting storm and sanitary sewer problems.

Although Miami Beach is only three miles from Miami, many of its problems and their solution are quite different from those of the latter city, which were described by Mr. Nichols in his article in the July issue. However, by the practical application of the hydraulic gradient principle, explained by Mr. Nichols, we were able to construct storm sewers at economical depths.

Since the easterly part of Miami Beach is composed of natural sand and the westerly part of fill pumped in on an old mangrove swamp, consisting of decayed vegetation, it has been found necessary to use the utmost care in the choice of pipe-line materials and the design of pipe-line foundations. The sewage and gases generated are destructive to some materials. The gases have attacked certain non-metallic materials, and deterioration has been rapid. In consequence, non-metallic materials not subject to deterioration are now used in gravity lines. Although there has also been deterioration of metallic pipe, the action has been slow. We, therefore, continue the use of metallic force mains, but add more metal thickness to the pipe than is customary. Metallic pipe laid last year was lined with a protective material. However, our experience indicates that careful study should be made before too much dependence is placed in a protective material. As a general rule, I believe that the basic material to be protected should be chosen with care. Then if the protective material proves unsatisfactory, no harm can result.

In most cases non-metallic pipe is provided with a concrete cradle, which strengthens the pipe, permits of shallow construction, and diminishes the tendency towards settlement. The latter factor in turn reduces the infiltration of obnoxious ground waters, thereby eliminating odors emanating from storm-sewer appurtenances and discoloration of boats anchored near storm-sewer outlets. In many instances the unstable mangrove material below the pipe is removed and the space backfilled with inundated sand.

Until recently the method of disposing of sanitary sewage consisted of pumping it into the ship channel, at the southerly end of the city, during the outgoing tides. In order to provide for continuous disposal and make economical extensions to our sanitary sewer system, a 36-in. outfall line discharging screened sewage into the Atlantic Ocean was constructed in 1937, and put into operation on December 17 of that year. The sewage is discharged into 40 ft of water, 7,000 feet offshore at 74th Street near the westerly edge of the Gulf Stream.

Results have been highly satisfactory during all operating conditions. An analysis of water taken during a very calm day about 1,000 ft from the outlet in the direction of flow of sewage showed that there were only 60 colonies of bacteria per cubic centimeter.

The main structural problem in the outfall line was to make the line secure against hurricane disturbances. Practically the entire length was placed in a rock trench with a minimum cover of 2 ft. Where this rock cover was deemed insufficient, a concrete cradle was placed around the pipe. The excavated rock, which was saved and used as backfill, has a high lime content, with a high cementing value. It is expected that the backfill material will eventually knit together into one solid mass, so that severe weather conditions will not disturb it. As insurance against severe conditions, which might occur before the backfill material has become re-cemented, concrete dams were placed every 250 ft across the trench to break the action of undertows.

MORRIS N. LIPP, M. Am. Soc. C.E.
City Engineer

Miami Beach, Fla.

Applying Mathematics to Job Getting

DEAR SIR: Because the subject is so close to my own work, I have been interested in W. L. Fitzgerald's article "Putting the Best Foot Forward," in the March number, and in the subsequent discussion. As Mr. Fitzgerald ably pointed out, there is a technique to job getting, but in general the man out of a job is much more concerned with thoughts of what a job will do for him than he is with the technique of how to get that job.

Hunting a job is no fun, but landing a job is a good deal like catching a string of fish, in that it requires some preparation, some effort, and a certain amount of luck. A little book entitled "Preparation for Seeking Employment," by Howard Lee Davis (John Wiley & Sons, publisher, price 25 cents) should be studied by everyone who desires to improve his technique of job hunting.

There is on old saying that it takes "pull" to get a job, and this is as true today as it was when it was first spoken because it takes into account the human elements that always react when one person employs another. When several people are trying for the same job, the one who gets it has more pull than the others, and I believe that an analysis of the elements that compose this pull will be interesting to engineers whether they are seeking employment or acting in the capacity of employers.

If we let I represent the initiative and intelligence shown by the applicant in his own behalf, S stand for his approximation to the employer's job specifications, and D represent the distance between the applicant and the employer, then P is a measure of the pulling power of the application in accordance with the basic formula $P \propto \frac{I \times S}{D^2}$. The same formula may be used to measure progress of personnel by letting D represent the distance between the employee and the employer or his responsible representative. You might even use the formula to compute the chances that any other candidate would have of beating the present incumbent if he runs for a third term because pull and politics are very similar and just another phase of the human equation.

NEWTON D. COOK
Manager, San Francisco Office,
Engineering Societies Employment Service

San Francisco, Calif.

SOCIETY AFFAIRS

Official and Semi-Official

Rochester Entertains Fall Meeting

Proves Delightful Host in a Splendid Technical and Social Program, October 12–14, 1938

Glorious fall weather and a warm welcome from an enthusiastic group of local members greeted the large group that gathered in Rochester, N.Y., for the Fall Meeting, October 12–14, 1938. The Hotel Seneca was the headquarters.

As early as the Saturday preceding the meeting, Board members began to gather for their preliminary committee sessions. The Board itself convened on Monday, when three sessions were held, and on Tuesday morning, adjourning at noon to permit its members to attend the all-day Local Section Conference, the meeting of the Technical Procedure Committee, and similar functions.

The meeting proper began on Wednesday morning, October 12. After the customary preliminaries of greeting and response, the program continued with a single illustrated paper, delivered by S. C. Hollister, M. Am. Soc. C.E., and covering the advances in structural theory since the publication of Galileo's theories in 1638. At the conclusion of this paper the business meeting was called. The only item on this part of the program was the report of the tellers who canvassed the ballots for amendment to the Constitution. This report is given in full in another item.

Technical papers and discussions had the right of way Wednesday afternoon. Much interest was shown in a group of papers arranged by the Waterways Division and dealing with a number of nearby flood-control operations under the jurisdiction of the Binghampton office of the U. S. Engineer Corps. Studies for the alleviation of serious flood conditions in the Genessee River at Rochester were explained in detail. Because of the great local interest in this subject the paper was broadcast for the benefit of the radio audience. A third related topic was the description of the operation of the Sacandaga Reservoir. An abridged article on this project appears elsewhere in this issue.

In an adjoining room the Structural Division presented another popular program centering around the new Thousand Islands Bridge across the St. Lawrence. Both the general features and the details of design and construction were featured. Following these addresses an informal discussion period rounded out the picture of this international project. Finally, a paper and the subsequent discussion described the extensive work undertaken by the city of Syracuse and the New York Central Railroad, in eliminating the grade crossings in that city and giving it a much-needed new passenger station. Abstracts of the papers on the bridge project are given elsewhere in this issue, while a paper on the Syracuse work will be found in the April 1936 number.

From this point on, the pattern of the technical part of the Rochester Meeting differed from the usual arrangement. Instead of one full day of meetings and another for excursions, both Thursday and Friday were divided, half to technical sessions and half to inspection trips. Three Divisions presented full programs on Thursday.

The Power Division devoted its program to a symposium on power plant design and efficiency, the papers in this symposium dealing with cost trends, turbine tests, and economical planning of hydroelectric plants. The Soil Mechanics and Foundations Division heard a paper on the practical application of soil mechanics in substructure problems, and one on settlement studies of structures. The latter is abstracted in this issue. Concurrently with these two sessions, the Sanitary Engineering Division presented a paper (also in this issue) on progress in the control of water pollution in New York State. Sanitary projects of interest that were also described at this session were the activated-sludge treatment plant of the Ley Creek Sanitary District and the new disposal plant at Buffalo, N.Y.

On Friday morning the Power Division and Soil Mechanics and Foundations Division held additional sessions. The former continued its symposium, with a paper on progress in the design of turbines and appurtenances, and one on the preliminary selection of hydraulic turbines and power house dimensions. The latter Division presented papers commenting on soil studies at the Muskingum Conservancy District and on recent developments in soil mechanics. The City Planning Division also held a session on Friday morning, which was devoted to a symposium on urban traffic control. After an introductory paper on the engineering aspects of the subject, there were specific contributions on traffic control in Buffalo and in Rochester.

Rochester is an industrial city. Two of its largest industries—the Eastman Kodak Company and the Bausch and Lomb Optical Company, entertained Society inspection trips on Thursday and Friday, respectively.

Kodak Park is the largest unit of the Eastman Company. In reality it is a city in itself, with its own transportation, fire, and other services. Immediately following the Thursday morning meetings, a large group of members and ladies were brought there by buses. After a cafeteria luncheon in one of the numerous buildings, there followed an inspection of many of the processes, including paper making, processing and manufacturing film into finished spooled rolls, together with the power generation, mechanical repairs, and construction of great numbers of special machines required by the industry.

A similar treat awaited the group which started out on a like trip immediately after lunch on Friday. The first stop was at the Taylor Instrument Company, home of the well-known manufacturers of barometers, thermometers, and automatic and other registering devices. Another short ride in the buses brought the visitors to the extensive plant of the Bausch and Lomb Company. Here many kinds of scientific instruments were seen in the making. Some of the work was in large-scale production as, for example, the grinding of lenses. At the other extreme was the interesting procedure of assembling microscopes, in which all the work on one instrument was done by a single craftsman.

While these visits were under way an independent group was being conducted through the Irondequoit Sew-

Donald H. Sawyer Selected as Official Nominee for President of the Society for 1939

It is provided in the Constitution that the Nominating Committee shall meet each year not later than October 15 for the selection of an "Official Nominee for President" for the following year. At such a meeting, held this year on October 10, Donald H. Sawyer, M. Am. Soc. C.E., was the unanimous choice for nominee to this important post, to serve during 1939. He has accepted, and his name will therefore be included in the final ballot to be canvassed next January.

Following service in the World War in responsible charge of cantonment construction, he was for a number of years a full-time officer of the Associated General Contractors of America at the Washington, D.C., headquarters. Trained in the Middle West at the University of Illinois, he has also had considerable experience on the Pacific Coast in irrigation, power, and municipal work. At present he is Chief of the Section of Space Control of the Procurement Division of the U. S. Treasury Department and President of the U. S. Housing Corporation.

In the Society his contacts have been similarly wide. They include terms as Director in 1926–1928 and as Vice-President for 1935–1936. His election will bring to the Society one of the youngest holders of its highest office.

A more complete biography of Colonel Sawyer is expected to be included in a later issue.

MANY INTERESTING LOCAL TRIPS WERE PROVIDED FOR WOMEN ATTENDING THE ROCHESTER MEETING

age Treatment Plant. Taken by private automobiles to the north of the city, they were shown details of arrangement and operation by members of the city engineering staff. This is an interesting Imhoff installation that has been in successful service many years.

One advantage of the Rochester type of program is that it gives the local ladies more time in which to entertain the women guests. Three such special programs were carried out most successfully. A luncheon and tour of the city on Wednesday afternoon provided an opportunity for getting acquainted with people and places. This program was varied on Friday by the substitution, after lunch, of a visit to Kodak Park. On Thursday an entirely different type of excursion was included. Taking a chartered bus, the group of ladies and a few men started for Niagara. After an hour at the Falls they embarked for old Fort Niagara, situated at the point where the river joins Lake Ontario. Luncheon at the Officers' Club at the Army post was followed by a visit around the historic fort, which has been restored according to its original plan.

The opportunity for general social functions was not overlooked. Wednesday evening was given over to the formal event of the meeting—the dinner dance at the headquarters hotel. The friendly atmosphere at that function was a fine tribute to the work of the local members.

Again on Thursday evening a joint entertainment was thoroughly enjoyed. For this purpose the spacious Eastman Theater was reserved. A not-too-technical talk explained the functional basis for the various systems of color photography, including that perfected by the Eastman Company for its products. Selections from recent color movies and reproductions of color photographs were used to illustrate the application of various methods. After a brief intermission the program continued with a series of musical treats, including numbers by the orchestra of the Eastman School of Music (Rochester University), consisting of more than a hundred musicians, and the *a capella* choir of the local Madison High School.

Two social events not included on the printed program should also be mentioned. Monday evening the local committee arranged an informal dinner for the visiting Directors and their wives. Again on Tuesday noon, the local committee joined Board members, this time as guests, at a luncheon.

In recalling the Rochester Meeting, the excellence of the preparations will stand out, and nowhere was this more evident than in the technical programs and in the smoothness with which advance plans had solved the difficulties of registration and similar matters. Owing to the efforts of the local members and their wives, who made the entertainment of the Fall Meeting their only concern for almost a week, Rochester will long be remembered for its hospitality.

Honorary Members Elected

IN accordance with Constitutional procedure, five distinguished engineers were elected to honorary membership in the Society at the Rochester meeting of the Board of Direction on October 10. They are:

C. Frank Allen, of Cambridge, Mass.
Anson Marston, of Ames, Iowa
Arthur S. Tuttle, of New York, N.Y.
Edward E. Wall, of St. Louis, Mo.
Frank E. Weymouth, of Los Angeles, Calif.

This list is notable for the fact that it comprises five recipients, the maximum allowed by the Constitution in any one year. Professor Allen is the oldest of the group—in fact he is one of the oldest members of the Society in terms of years of affiliation; he is particularly known and loved by former students of the Massachusetts Institute of Technology, where he taught railroad engineering for almost thirty years. A similar record and a similar vocation characterize Dr. Marston, who served even longer on the engineering faculty of Iowa State College, including three decades as dean. Mr. Tuttle's professional lifetime was devoted to the service of the city of New York, where he rose to the highest engineering office, that of chief engineer of the Board of Estimate and Apportionment. Likewise, Mr. Wall has served the city of St. Louis for the past forty years, almost continuously—and in fact he still actively serves it; for many years he served as water commissioner and more recently as director of public utilities. Mr. Weymouth's early work was with the Reclamation Service, in which he rose to the office of chief engineer. Latterly he has been chief engineer and general manager of the Metropolitan Water District of Southern California in developing and constructing its huge Colorado River Aqueduct.

The ceremony in recognition of these eminent engineers and their outstanding achievements will take place at the Annual Meeting of the Society in January 1939. More complete records of those honored will be included in a later number of CIVIL ENGINEERING.

Prize Awards Made for 1938

BASING its approval on the report of its Committee on Prizes, the Board of Direction at its meeting on October 10 confirmed the selection of the following as winners of Society prizes for 1938:

The Norman Medal to Hunter Rouse, Assoc. M. Am. Soc. C.E., for his paper entitled "Modern Conceptions of the Mechanics of Fluid Turbulence."

The J. James R. Croes Medal to Ernest C. Hartmann, Assoc. M. Am. Soc. C.E., for his paper entitled "Structural Application of Aluminum Alloys."

The James Laurie Prize to Leon S. Moisseiff, M. Am. Soc. C.E., for his paper entitled "Evolution of High-Strength Steels Used in Structural Engineering."

The Arthur M. Wellington Prize to Charles M. Noble, M. Am. Soc. C.E., for his paper entitled "The Modern Express Highway."

The Collingwood Prize for Juniors to Douglas M. Stewart, Jun. Am. Soc. C.E., for his paper entitled "Behavior of Stationary Wire Ropes in Tension and Bending."

All the foregoing papers will be found in Volume 102 (1937) of TRANSACTIONS. Awards of these honors will be made an important part of the general session at the Annual Meeting of the Society on January 18, 1939.

Appointments on Division Executive Committees Made for 1939

EACH year one new member is added to the executive committee of each Division, to take the place of a member whose five-year term is expiring. Appointments are made by the Board, selecting from one or more names submitted from the Divisions themselves. Such was the routine completed by action of the Board at its Rochester Meeting.

In addition, there was the necessity this year of setting up a full executive committee for the newly established Hydraulics Division. Its members were designated for varying terms, but with this exception the following new members will serve the executive committees of their Divisions for five years:

Division	Nominee
City Planning	Harland Bartholomew
Construction	David Bonner
Engineering Economics	J. H. Porter
Highway	C. E. Myers
Irrigation	H. C. Neuffer
Power	Philip Sporn
Sanitary Engineering	A. Clinton Decker
Soil Mechanics and Foundations	Carlton S. Proctor
Structural	Glenn B. Woodruff
Surveying and Mapping	W. N. Brown
Waterways	R. E. Bakenhus
Hydraulics:	
Term ending 1944	Fred C. Scobey
Term ending 1943	Gerard H. Matthes
Term ending 1942	B. A. Bakhmeteff
Term ending 1941	J. C. Stevens
Term ending 1940	Charles H. Paul

Resolution Adopted by Committee on Fees

Approved by the Board of Direction, October 10, 1938

WHEREAS, the American Society of Civil Engineers has previously expressed its approval of proper safeguards through civil service for tenure of position for those members of the engineering profession who are engaged in engineering work which is a proper function of political divisions and public agencies;

WHEREAS, there has been an increasing encroachment of organizations under civil service into fields which have heretofore been occupied by members of the engineering profession engaged in private practice, which extensions of the civil service system have operated to the detriment of the engineer in private practice in taking from him opportunities to practice his profession in fields in which he and his organization are particularly qualified and in which specialized experience and training are of great value;

WHEREAS, the engineer in private practice has contributed and will continue to contribute in vital manner to the growth and development of the engineering profession; and

WHEREAS, it is in the public interest and benefit that the special abilities and specialized experience of the private engineer and his organization should always be available to public agencies;

Therefore, be it resolved, that the Board of Direction of the American Society of Civil Engineers expresses its disapproval of all proposals which would unduly restrict the field of activities of the engineers engaged in private practice, and particularly its disapproval of any laws which would serve to deprive the public of the benefits to be derived from the services of the private engineer and his organization;

And be it further resolved, that the Board of Direction of the American Society of Civil Engineers does reaffirm its approval of safeguards for tenure of position under civil service for engineers in the service of the public.

Vote on Constitutional Revisions

Tellers' Report to Society Fall Meeting, Rochester, N.Y., October 12, 1938

October 12, 1938

To the Secretary
American Society of Civil Engineers:

The tellers appointed to canvass the Ballot on Amendment to the Constitution report as follows:

Total number of ballots received		2,753
Ballots excluded from the canvass:		
From members in arrears of dues	71	
Without signature	6	
Total ballots not canvassed		77
Ballots canvassed		2,676
Yes		1,474
No		1,196
Blank		5
Void		1
Total ballots canvassed		2,676
Total votes counted (Yes or No)		2,670
Required to carry		1,780
Lost by		306

Respectfully submitted,

A. L. VEDDER, *Chairman*

I. E. Matthews
H. A. Zollweg
P. A. Covas
H. G. Lehrbach
Willard F. Pond
James C. Bell
Tellers

Committee on Professional Objectives Named

PURSUANT to the authorization, by the Board of Direction on July 17, of a permanent Committee on Professional Objectives, the following members of the Society have been appointed to the committee: E. R. Needles (chairman), Frederick Bass, Ivan C. Crawford, W. W. De Berard, Henry L. Fruend, Carlton S. Proctor, and A. M. Rawn.

As explained in the September issue of CIVIL ENGINEERING (page 572 and 620), the fundamental aim of this group is to encourage the discussion of problems of a general professional nature, public relations, the social responsibilities of the engineer, and similar questions. It is to function as an agency through which both salaried and employer engineers may express themselves more fully on professional matters, and is to give particular attention to the economic and social status of the engineer.

The appointments include three Board members and four non-Board members.

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Problems Before the Society

A Member of the Board of Direction Presents His Thoughts on a Variety of Vital Topics

By LOUIS E. AYRES, M. AM. SOC. C.E.

DIRECTOR, DISTRICT 7; CONSULTING ENGINEER, ANN ARBOR, MICH.

The convention of the members of District 7, held at Houghton, Mich., on August 25–27, had as one of its objectives the discussion of a number of administrative and organization problems—"to the end that the membership of the District might become better informed and stimulated to increased activity in Society affairs." Director Ayres opened the conference with an exposition of problems before the Society as he saw them, and his remarks, presented here in essentially their complete form, laid the foundation for a full day of discussion.

THE Society is confronted with a number of problems, many of which are of relatively recent acceptance, and being primarily local or regional, must be solved by the Sections or by groups of Sections. This situation places a new responsibility on the Section and on the District. The extent to which the membership responds to these new obligations will determine whether the Society goes forward or falls back in the years immediately ahead.

MAJOR PROBLEMS

In his Salt Lake City address, President Riggs listed the "three major problems before the Board" as (1) Local Sections, (2) Junior members, and (3) Technical Divisions. The first two are primarily problems for the Sections and the third primarily one for the Board of Direction.

After a long struggle in the Board, approval was recently given to an amendment to the By-Laws whereby a much larger sum of money is being, and is to be, returned to Local Sections. The sponsors of this change believe in Local Sections. They believe that the future growth and strength of the Society will depend upon the success of the Local Sections. It is now squarely the obligation of the Local Sections to demonstrate that their friends were correct, that the Local Section is a vital unit of the Society in many matters and that the money returned will be expended wisely and in the best interest of the members. To do this, Local Sections must (1) increase their corporate membership, (2) carry on active programs of service, both to their Corporate Members and to their Juniors, and (3) exert professional leadership in cooperation with other professional men in their several areas.

After another struggle, the Board is about to experiment with new machinery in the interest principally of the Juniors. At the Salt Lake City Meeting a permanent committee was established "to be known as the Committee on Professional Objectives and to consist of seven Members, which Members shall be selected with due regard to geographical location, interest in the proposed activities, standing in the profession, and qualities of leadership and willingness to assume leadership in dealing with pioneer problems in the Society." This committee is an experiment. It has been given wide powers to meet a widespread demand. It may or may not be the right approach to recognized obligations but at least it is a prompt start along lines of activity that can hardly be avoided. It is an immediate attempt on the part of the Board of Direction to carry out the thesis of President Riggs in his Salt Lake City address, that the leadership of the Society "must be in all matters that pertain to the social, economic, and political welfare of the engineer as well as in his practice, ethics, and scientific perfection."

The problem of the Juniors goes to the very core of the present and future objectives of the Society. In the past the Society has been a purely technical group, interested mainly in technical enlightenment and progress. Engineers have joined to improve their technical knowledge and to gain the prestige of membership, and some claim the dues are high for these purposes. Now, doubtless as a result of experiences in the past few years, it appears that a large number of members seem to be less interested in technical discussion and literature than they are in matters affecting their well-being and the welfare of the profession.

It may be urged that problems other than technical may best be served by groups organized for non-technical purposes. It seems to me that the problems of engineers will be solved, if at all, by engineers, and not by salesmen or politicians—as that term is usually defined. The requisites for the success of any group that undertakes to be active in connection with the "social, economic, and political welfare of the engineer" are (1) personnel of entire membership, (2) stability of organization, and (3) financial resources. The Society possesses these requisites. The question is, should we devote a part of our energies to these objectives? Can we do so effectively without sacrifice of our original purposes, as expressed by the Constitution: the "advancement of the science of engineering," the "professional improvement" of our members?

One of the very important aspects of any Local Section's work is that done by its membership committee. With recent changes in the machinery of passing on applications, the local membership committee plays a most important rôle. In the process of ascertaining all facts concerning an applicant for membership or transfer, all possible sources of information are utilized, including former employees, college records, sponsors, and local committees. Sponsors are frequently careless in passing on applicants and particularly in grading applicants. Few members seem to realize that there is a distinct difference between "responsible charge" as applied to an Associate Member and to a Member. A common failure to make this distinction explains, no doubt, the apparent laxity of many sponsors.

It is important that the quality of our membership be maintained and that undesirable applicants be rejected. To achieve this result, careful attention and conscientious effort are required of the local membership committees. These committees are sometimes dilatory and superficial in their reports. They fail to report promptly, and follow-up letters are required from Headquarters. In every possible instance the applicant should be interviewed.

Local membership committees should also give more attention to the possibilities of securing new members in their areas, particularly in the corporate grades. The activities of the colleges in recent years have brought an abundance of members in the Student Chapters and considerable numbers of these have gone on into the Junior grade. The result has been, as pointed out in Professor Riggs' Presidential Address, an increase in Juniors in the past 12 years of from 1,000 to 3,736, or from $9^1/_2$ per cent to nearly 24 per cent of the total.

THE PROBLEM OF THE TECHNICAL DIVISIONS

The third major problem, namely, that of the Technical Divisions, is expressed by President Riggs in the form of a question which also involves the publications of the Society. These combined subjects are too complex for anything more than cursory comment at this meeting, but they are vital and difficult and should receive the considered thought of many members. It is no doubt true that the failure of the Founder Societies in earlier days to provide the opportunity and machinery within their ranks necessary to serve the increasingly diversified interests of developing professions led to the formation of many new societies. To what extent in past years railroad, highway, structural, sanitary, and other classes of engineers could have been better served by the Society than they were, and thus drawn to it and held as members, is uncertain. Sixteen years ago a move was started, through the formation of Technical Divisions, to forestall the further departure from the Society of specialized groups whose interests needed special attention. Now we have 12 Divisions, and more in prospect, operating through more than 60 committees. Each Division involves some cost. Last year a total of perhaps as much as \$10,000, not counting the additional costs of printing papers and other material, was expended through the Divisions.

The principal problem seems to be that there may be overlapping of effort and that the Society's publications perhaps fail to meet the full desires of the Division members. With the increase in the number of Divisions, this situation will become more complicated and the costs will mount. Is the tendency desirable or otherwise, and what may be done to better correlate all of our technical activities?

It has been suggested that the entire scope of interests of civil engineers might be comprehended within a compact and logical

framework into which all activities would fit. Thus general vertical groups might be considered as comprising:

1. Planning and public works
2. Foundations and structures
3. Water uses, including irrigation, drainage, waterways, flood control, etc.
4. Power—water, steam, and diesel
5. Sanitation and public health
6. Transportation—land, water, and air

with such horizontal divisions as:

1. Research
2. Finance and economics
3. Surveying
4. Construction

Would such a framework be feasible and helpful? Or would it be artificial and forced as contrasted with the present "natural" growth?

The relationship between such a set-up of vertical groups and horizontal divisions to the problem of publications is far from obvious. At the present time the Society spends nearly $150,000 annually, or about 40 per cent of its gross income, on publications. Most material suitable for publication, as judged by present methods of review, is published. The quantity is increasing and the annual budget allowance is barely requisite to meet the growing demands. At present all material printed is supplied to all members. This year about 1,600 pages will probably be printed twice, first in PROCEEDINGS and then in TRANSACTIONS and go out to substantially 16,000 members. Such a procedure has been feasible in the past. Can it be continued long into the future? Because of the widely varying technical interests of the membership, a large proportion of the printed matter now delivered to each member is of no current interest and much of it is probably of no future interest to him. If it were practical to supply each member with only such printed matter as might be of interest to him, would his interests be better served and some economy be effected?

For the purpose of stimulating suggestions, I should like to make a parenthetical comment or two regarding CIVIL ENGINEERING. It is now generally agreed that CIVIL ENGINEERING has become a valuable publication. Why do you think it valuable, if you do? Is it because of a technical interest in numerous short readable technical papers, or because it brings to you some knowledge of Society activities? On the theory that the latter should be the major objective of CIVIL ENGINEERING, it may be modified gradually to place more emphasis on the non-technical happenings in meetings of Local Sections, Section conferences, and the Board of Direction. Do you approve of such a gradual metamorphosis of CIVIL ENGINEERING?

CIVIL ENGINEERING is largely financed through advertising. Do you approve of such a procedure? Between $40,000 and $50,000 of revenue comes annually from advertising. By energetic salesmanship this amount might be materially increased. Should it be increased or held to about its present volume and quality, in order that the funds may be found to maintain CIVIL ENGINEERING?

OTHER MATTERS

And now may I not be permitted to mention a few of the many problems that are confronting Board members and concerning which the membership generally should have some knowledge and should be given an opportunity to express opinions.

Financial. The Society is in a substantial financial condition. Our annual income is in excess of $400,000. We have assets of upwards of $1,500,000 which return a net income in excess of $60,000 annually. This year the Society will receive in dues, fees, and sales upwards of $300,000, and advertising receipts will amount to perhaps $40,000. Just exactly how we spend this money, from a functional standpoint, is not clearly obvious from our present books, but accounting changes are in process of being effected which will show more specifically the cost of various activities. In general, it takes about one-half the gross income, or about $200,000 annually, for general administration; about $150,000 for publications; and the remainder is given to the Local Sections, to the Technical Divisions, and to various committees. We give $15,000 annually to the support of other groups such as American Engineering Council, American Standards Association, Construction League of the United States, Engineers' Council for Professional Development, and the National Council of State Boards of Engineering Examiners; and we contribute about $12,000 a year to outside activities such as the support of the Engineering Societies Library and the Engineering Societies Employment Service. To what extent any of the expenditures should be curtailed or increased is of vital moment. It is a matter of particular concern in view of what happened in January 1938. Facing a budget deficit at that time, the Board of Direction made its principal deduction from the moneys returnable to Local Sections, based on a recently adopted By-Law. Although actually the Local Sections will receive this year about twice the amount received last year, nevertheless the objective of the Board is at present impossible of accomplishment Admitting no easy alternative then, is there none in the future? Obviously, the answer rests with the Sections.

The Society contributes $12,000 annually to the support of American Engineering Council. Although there are probably but few members who would withdraw this support at the present time, there is serious question in many minds as to the value of the service performed by Council and the means, if any, that may be taken to justify a continuous outlay. We are impressed by an ideal and the desirability of certain objectives but we have reason to be discouraged over recent accomplishments. A joint committee on which your Board is represented is now at work on this difficult problem.

Policies. There is a growing tendency for the Board of Direction to seek the advice of the membership on matters of public policy. Heretofore the Board's rule has been to deny publication of any committee report until the recommendations thereof had been approved. This policy has avoided trouble but has led to a delay in publication, in some instances to an extent that the value of the recommendations or resolutions may have been largely lost. In two recently considered matters, the Board of Direction has ordered advance publication in CIVIL ENGINEERING of committee reports with the hope that by so doing valuable comment may be secured from members to aid in the determination of Society policy, which must finally be made by the Board. This new plan of procedure offers an opportunity for members at large to discuss and possibly influence Board action on important matters involving public policy and federal legislation. Will the membership take advantage of this opportunity?

Nominees for Society Offices for 1939

THE full list of official nominees for Society election in 1939 is brought into being by the results of the Second Ballot canvassed October 15, plus the selection of the Nominating Committee for President. Details of these procedures are noted elsewhere. In addition, the arrangements were complicated this year by the death of one prospective candidate between the times of voting and of canvassing the second ballot, thus necessitating Board action. The results of these various procedures, all in accordance with the provisions of the Society Constitution, give the complete list of official nominees for 1939, as follows:

For President:
Donald H. Sawyer, of Washington, D.C.

For Vice-Presidents:
Zone II, Charles M. Reppert, of Pittsburgh, Pa.
(Takes the place of candidate Richard Khuen, Jr., whose death on September 24 required that the Board of Direction make a substitute nomination. Accordingly the Board on October 10 designated Mr. Reppert as official nominee for vice-president from Zone II.)
Zone III, James L. Ferebee, of Milwaukee, Wis.

For Directors:
District 1, H. W. Hudson, of New York, N.Y.
Harold M. Lewis, of New York, N.Y.
District 4, Sanford W. Sawin, of Wilmington, Del.
District 11, Charles T. Leeds, of Los Angeles, Calif.
District 14, Robert B. Brooks, of St. Louis, Mo.
District 15, Edward S. Bres, of New Orleans, La.

The remainder of the procedure for election will follow the course provided by the Constitution. That is, a final ballot for all Society officers for 1939 will be forwarded to Corporate Members at least forty days before the Annual Meeting in January. These ballots will be canvassed a week before the Meeting so that announcement may be made at the business session of the Annual Meeting. The new officers are then immediately inducted into office, their terms beginning from that moment.

Presidents of the Society

XXXII. ROBERT MOORE, 1838–1922

President of the Society, 1902

ROBERT MOORE, prominent in the early engineering development of St. Louis, was a second-generation engineer. His father, Henry Clay Moore, was the builder of the White Water Canal in Indiana, and of a number of the pioneer railroads of the Middle West. Under him the son received his early training, serving as rodman during his school vacations in the late 1850's.

Apparently young Moore remained with his father for some years after his graduation from Miami University in 1858. Then, during the Civil War, he was engaged as a civilian engineer by the Engineer Corps of the Federal Army, and assisted in the construction of fortifications in Kentucky. Later, and until 1877, he was in railroad work—sometimes alone, sometimes as assistant to his father—on lines in Ohio, Indiana, Illinois, Missouri, and Kansas.

ROBERT MOORE
Thirty-Second President of the Society

In 1876 the city of St. Louis adopted a new charter, which provided for a board of public improvements to have charge of the engineering work of the city. Moore was selected as one of the five members (all of whom were engineers) and acted as sewer commissioner from 1877 to 1881. It is said that the efficient handling of public affairs by this board gave the profession a standing and prestige in St. Louis that had a large and lasting influence on the government of the city.

In 1881 Moore left the board to devote himself to a consulting practice that continued into his eighty-second year. His engagements were mostly in the field of railway engineering, and one of the first was the construction of landing arrangements for a car ferry at the Mississippi River terminus of the Belleville and Carondelet Railroad, opposite the southern limits of the city of St. Louis.

His next important work in that vicinity was as chief engineer of the St. Louis Merchants' Bridge Terminal Railway. This project was designed to unite the various railway systems in the city with the Merchants' Bridge, over the Mississippi River, and it included somewhat more than a mile and a half of double-track elevated structure designed to carry the heaviest freight locomotives. It was completed in 1890.

By 1905 St. Louis was again outgrowing its terminal facilities. Freight tonnage received and forwarded in its metropolitan area had doubled in the preceding seven years, and at that time amounted to over 39,000,000 tons annually. With the development of the "Southwestern trade" it seemed probable that a similar rate of increase would continue for some time. Accordingly the Municipal Bridge and Terminals Commission engaged Moore and Albert T. Perkins as consulting engineers and advisers, to prepare plans for improving the terminal facilities. Their recommendations, which included the construction of freight houses, team tracks, storage yards, and an additional bridge across the Mississippi River, were a valuable contribution to the later development of the area.

Between these engagements, and in later years, Moore served variously as consulting engineer for the St. Paul and Duluth Railway and for the reorganization committees of the St. Louis Southwestern Railway, the Rio Grande Western Railway, and the Santa Fe System; as chief engineer of the St. Louis, Peoria, and Northern Railway and of the Wabash, Chester, and Western Railway; and (from 1900 to 1920) as special consulting engineer on the Missouri and Mississippi River bridges for the Chicago, Burlington, and Quincy Railway.

In 1897 he was a member of the Brazos River board which reported to Congress on the works at the mouth of the Brazos River and their value to the government, and in 1899–1900 he was a member of the Southwest Pass board which reported to Congress a plan for deepening the Southwest Pass of the Mississippi River.

In addition to his professional work, Moore found time to take an active part in the educational affairs of St. Louis. In 1897, public indignation over the conditions in the public school system resulted in doing away with the old system of "ward representation" on the board of education and the setting up of a twelve-member "reform" board to take its place. Moore was one of the twelve, and although his election came at the age of 59, he not only served through his original term, but through successive terms continuously for sixteen years. He was president of the board in 1906 and again in 1910 and during practically the whole period of his services, when not holding the office of president, he was at the head of one of its important standing committees.

This period, state the writers of his memoir in TRANSACTIONS (1923) was the time of greatest improvement and development of the public school system in St. Louis. "It was brought from an exceedingly low ebb of inefficiency to a high tide of successful administration, taking its place easily as the best in the United States and the model for the work of other cities. It is not too much to say that this attainment was largely the result of Mr. Moore's quiet courage and intelligent labors."

Moore also engaged actively in the "ethical movement" in St. Louis. He became chairman of the Ethical Society in 1891, and, thereafter, until disabled by ill health, he remained as its active civic representative and its guiding spirit. "He worked for his creed with an unselfishness, a devotion, and a persistence worthy of the best traditions of his Puritan ancestors."

Despite the spirit of independence which was one of his most marked characteristics, Moore was quiet, dignified, and reserved. He had a fine sense of fairness and justice—and this trait was so generally recognized "that in all the work coming under his charge he never had any disputes to litigate." His connection with the Society dated from 1876, and before his term as President in 1902 he had served both as Director (1892–1893) and as Vice-President (1888, and 1899–1900). He was also a member of the Institution of Civil Engineers of Great Britain (London) and president of the Engineers Club of St. Louis and the St. Louis Academy of Sciences. He died on July 24, 1922, survived by his wife and one son.

Local Sections Hold Fall Outings

MANY of the Local Sections display great ingenuity in arranging programs that avoid the stereotyped. For instance, the Kansas State Section and the Buffalo Section recently provided interesting gatherings for their members in the form of fall outings.

About 95 members and guests of the former Section met with the Topeka Engineers Club on September 24 for an afternoon of varied activities. First, a four-reel motion picture showing the construction of the new Topeka Avenue Bridge was presented. The film gave a good background for the inspection trip to the site of the bridge which followed. The group then assembled in Gage Park, where they enjoyed a baseball game. A picnic supper in the park concluded the festivities.

A slightly more formal outing was enjoyed by the members and friends of the Buffalo Section on September 30, the occasion being the second annual golf tournament, followed by a dinner at the Park Country Club. Postponed once on account of rain, the tournament proved very enjoyable, and several prizes were awarded. George S. Minniss, president of the Section, presided at the dinner and announced the Rochester Meeting of the Society. His remarks were supplemented by a talk by Edward P. Lupfer, former Vice-President of the Society, who also stressed the advantages of attending the Meeting. Colonel Minniss then introduced the speaker of the evening—Bill Pitts, radio broadcaster and member of the staff of the *Buffalo Evening News*—who entertained with his reminiscences.

Student Prizes Awarded

During the past commencement season many of the Local Sections of the Society followed their annual custom of presenting awards to engineering students graduating with high academic distinction from colleges and universities within their territories. The awards vary, consisting generally of payment of the recipient's initiation fee as a Junior in the Society and, in some cases, of his dues for one year. In all cases the awards are contingent on the favorable action of the Board of Direction upon the recipient's application for membership. Word of the following prize winners for 1938 has been received at Society Headquarters.

Name of Student	College	Local Section Giving Award
John Glen Teas	University of Alabama	Alabama
Ervin Linwood Thomas		
George L. Haynes, Jr.	University of Arizona	Arizona
Fred J. Kile	University of Illinois	Central Illinois
James M. Robertson		
Robert Jaborowski		
Charles Lewis Guard, Jr.	Ohio State University	Central Ohio
Sven Erik Sjodahl	University of Cincinnati	Cincinnati
Karl Blackburn	Ohio Northern University	Cleveland
Seth Phillips Osgood	Case School of Applied Science	
Clarence Symns, Jr.	University of Akron	
Jack Dickerson Brooks	University of Colorado	Colorado
Paul W. Downey	George Washington University	District of Columbia
William L. Hechmer	Catholic University of America	
Sam Floyd Warren	University of Florida	Florida
Harold Everett Goeke	University of Illinois	Illinois
Randolph N. Jacobson	Northwestern University	
John E. Lindeman	Rose Polytechnic Institute	
Nando J. Petterine	Lewis Institute	
William F. Schlax	Armour Institute of Technology	
Frank T. Sheets, Jr.	Purdue University	
Henry Forrest Hill	Purdue University	Indiana
Joseph Lee Waling		
Myron Secrist Berry	Iowa State College	Iowa
William R. Winkelholz	State University of Iowa	
Jack Wilcox Gaul	Cornell University	Ithaca
Frank M. Cortelyou, Jr.	University of Missouri	Kansas City
Sanford D. Blattner	Kansas State College	Kansas State
Byron Norvin Souder	University of Kansas	
Xavier S. Hutchins	University of Louisville	Kentucky
Roland Wynns Pride	University of Kentucky	
Herbert Weese Harker	Lafayette College	Lehigh Valley
Warren B. Woodrich	Lehigh University	
Ernst Albert Bullington	Louisiana State University	Louisiana
John Seyburn Burk	Tulane University	
Peter Sterling	University of Southern California	Los Angeles
Le Van Griffis	California Institute of Technology	
John E. Duberg	Manhattan College	Metropolitan
William J. Hoffman	Columbia University	
Frederick G. Lehman	College of the City of New York	
Melville H. Lyman, Jr.	Newark College of Engineering	
Sanford Koretsky	Cooper Union	
Joseph Nachay	New York University	
Howard J. McCrodden	Polytechnic Institute of Brooklyn	
Jack C. Radcliffe	Rutgers University	
Mark Waldemere Olson	University of Minnesota	Northwestern
Kenneth W. Person		
Paul B. Donaldson	South Dakota State School of Mines	
Odin S. Hanson	University of North Dakota	
Robert R. Penman	North Dakota State College	
Douglas A. Bowers	Oklahoma Agricultural and Mechanical College	Oklahoma
Robert Scott Moore	University of Oklahoma	
Holley Adams Cornell	Oregon State College	Oregon
Thomas Nelson Creacy		
Robert Charles Lipman	University of Pennsylvania	Philadelphia
Alexander C. Mowbray	Drexel Institute of Technology	
Daniel R. Beech	Carnegie Institute of Technology	Pittsburgh
William Davis	University of Pittsburgh	
Charles B. Soloman	Rhode Island State College	Providence
Edgar F. Sanborn, Jr.		
Eugene Bertram Lanier	Missouri School of Mines	St. Louis
Waldemar J. Klasing	Washington University	
Edward Leonard Pine	University of Nevada	Sacramento
Myron Ellsworth Page	University of California	San Francisco
Brooks T. Morris	Stanford University	
Giro Gerald Kubo	University of Washington	Seattle
Henry Downs Byrd	Clemson College	South Carolina
Joseph Francis Campbell	University of South Carolina	
Walter Price Wagoner	The Citadel	
Chalmers Harvey Thornber	Montana State College	Spokane
Gomer Condit	University of Idaho	
Charles Thomas Bagley	University of Tennessee	Tennessee Valley
James Mason Tuttle		
Seymour S. Taylor	University of Utah	Utah
Dean Edward Bischoff	Utah State Agricultural College	
Ivan Maxwell Teuscher		
Lloyd Thomas Olsen	University of Virginia	Virginia
Alvin R. Schwab	Virginia Polytechnic Institute	
Thornton W. Campbell	Virginia Military Institute	
Donald Cameron Peters	Marquette University	Wisconsin

Other awards of Junior membership in the Society made at commencement time were those of the Milo S. Ketchum Award to Robert Marvin Mains, of the University of Colorado, made by the Colorado Section; and the Dam Club Prize to Frederick G. Lehman, of the College of the City of New York.

Forecast for November "Proceedings"

Great Lakes Transportation
By M. C. Tyler, M. Am. Soc. C.E.; Brigadier General, U. S. Corps of Engineers
This paper, originally scheduled for the October "Proceedings," was unavoidably delayed until the November issue.

Analysis of Runoff Characteristics
By Otto H. Meyer, Assoc. M. Am. Soc. C.E.
A method of determining hydrographs of flood flow under three sets of conditions: (1) where a unit hydrograph may be derived from available hydrographs; (2) where a unit hydrograph may be developed by a transposition from a hydrograph at another point; and (3) where a hydrograph may be prepared from rainfall and other considerations, in the absence of any accurate stream-flow measurement.

Simplified Wind Stress Analysis of Tall Buildings
By Otto Gottschalk, Esq.
Is based on a purely geometrical concept developed from observations of model deformations.

Specifications and Design of Steel Gusset Plates
By T. H. Rust, Assoc. M. Am. Soc. C.E.
Practical information about the structural steel details designed to transfer force from one member to another in a structural steel frame.

Tests on Built-Up Columns of Structural Aluminum Alloys
By Marshall Holt, Jun. Am. Soc. C.E.
Computed and measured strengths of columns compared.

State-Wide Surveying Practice in Massachusetts: A Symposium

Establishing a System of Rectangular Coordinates
By Elmer C. Houdlette, Esq.
Relief agencies utilized to develop valuable state-wide survey embodying plane coordinates, basic levels, and extensive publications.

The Land Court and Its Engineering Procedure
By Clarence B. Humphrey, Esq.
Describes a system whereby the Commonwealth grants indefeasible land titles, based on engineering surveys.

Design of Dowels in Transverse Joints of Concrete Pavements
By Bengt F. Friberg, Assoc. M. Am. Soc. C.E.
Practical suggestions for the design of dowels, based on the author's theory.

Transportation Developments in the United States
By Fred Lavis, M. Am. Soc. C.E.
Reviews the problems of the nation's transportation agencies, emphasizing the plight of the railroads and offering a solution.

Land Surveys and Titles: Progress Report of the Special Committee of the Surveying and Mapping Division on Land Surveys and Titles, in Cooperation with the Real Property Division of the American Bar Association
Suggests the state plane coordinate system as a remedy for the discrepancies and inexactitudes usually present in boundary locations.

A Prize-Winning Student Paper

Typical of Many Which Last Year Received Awards from Local Sections Throughout the Country

Each of the Local Sections that awards prizes to members of nearby Student Chapters has its own plan for selecting the winner. Many of them, however, base the award on the preparation and presentation of technical papers. Typical of these is the Seattle Section, which annually pays the initiation fee to the grade of Junior for one member of the University of Washington Student Chapter. The contest is held at a joint meeting of the Section and the Chapter, near the close of the school year. Last year's winning paper is presented here as an example of student work; except for an abridgment to about two-thirds its original length, it is essentially unedited.

Cavitation and Its Effect on Turbines

By GIRO G. KUBO

CAVITATION of turbine runners has been the subject of a great deal of discussion and speculation during the last few years. The pressing demand of turbine users for higher and higher speed machines in order to reduce the initial cost of the generators and the tendency or temptation of designers to "go the limit" in determining the head on Francis, Kaplan, and propeller turbines, have forced the manufacturers to do a great deal of research and experimentation in order that they can guarantee with greater safety the performance of their machines.

It is a well-known fact that the cavitation limit, the static suction head at which cavitation sets in, is one of the most stringent limiting factors of the urge for higher speeds for the sake of greater working capacity of turbines at the present day.

The study of cavitation was first started in 1915 by the English Admiralty when the high-speed propellers of the *S. S. Mauretania* were found to be severely pitted. However, Professor Fottinger of Germany is credited with the present version of the vapor generation and condensation phenomena of cavitation. It was he who dispelled the corrosion theory by showing that cavitation affects glass, a substance which is chemically and electrolytically inert.

Cavitation, in relation to hydraulic turbines, is a difficulty which is encountered, particularly with high-speed runners, because of the reluctance of the water to follow the back side of the runner vanes when the draft or suction head is high. Experience has shown that propeller turbines with fixed blades or of the Kaplan movable-blade type, as well as reaction turbines, must be repaired from time to time.

The pitting which results at certain spots on the buckets is characterized by a roughened surface resembling melted lava. In extreme cases holes one inch in diameter or larger have been found eaten through the material. There critical spots are located on the back side of the bucket of a Francis reaction wheel. In a propeller turbine, the pitting occurs on the suction side. Pelton wheels are subject only to local cavitation due largely to irregularities in the surface.

The theory generally accepted at the present time is that cavitation is mechanical in its nature. It is caused by the extremely rapid fluctuations of pressure due to the repeated formation and collapse of vacuum pockets or cavities adjacent to the material. Rough approximations have shown that pressures as high as 1,000 atmospheres are possible. These fluctuations act on the blade like the blows of a hammer, gradually weakening and ruining the material. The blows occur on the order of 20,000 per sec.

Another force which accelerates the removal of the particles is found in the scouring effect of the tangential component, since the water is flowing along the material.

The minimum requisite to prevent cavitation is that nowhere on the reverse side of the runner blade or bucket must the absolute pressure fall to or below the vapor pressure of the water, which is a condition inseparable from cavitation.

In water turbines this fall in pressure may be the result of any combination of six factors: (1) An excessively high static suction head, (2) a high absolute velocity of discharge, (3) high efficiency of the draft tube, (4) violent alterations in the direction of flow such as are caused by faulty bucket angles at intake and by the highly curved blade surfaces, (5) high relative velocities in the buckets due to high head or to the high specific speed—conditions which are being reflected in present-day practice, and (6) formation of eddies or vortices as a result of disturbances in the waterways. It can be seen at once that the problem of minimizing or eliminating conditions of cavitation is an extremely complex one.

A great deal of consideration is now being given to the improvement of the design of the turbines, together with the general arrangement of the turbine such that the maximum static suction head will be approached but not exceeded—research which must be done experimentally rather than by theoretical considerations.

The testing of scale models, as well as observations of actual installations, with all their inherent errors and difficulties, has made possible closer approximations in practice. Curves plotting head against specific head have been drawn by compiling data from plants now in operation and drawing a line between the plants in which pitting is experienced and those in which pitting is mild or negligible. A glance at this curve shows the maximum safe specific speed at which a given turbine could be operated with reasonable assurance that cavitation would be no serious problem.

Another line of investigation is in determining the degree of pitting on different materials. At the Massachusetts Institute of Technology a great deal of work has been done by placing the specimen in a venturi tube and subjecting it to the cavitation action of great intensity which results when water is passed at high velocities through the restricted area followed by a more or less sudden expansion. More recently, these tests have been carried out by mounting the specimen on the end of a vertical metal rod, immersed in the fluid, and set into vibration by means of an electrical oscillation circuit with a frequency of 7,000 cycles per sec.

As a result of a search for the most suitable material to resist pitting, three theories have been suggested. The best material is the one having the highest corrosion fatigue limit, the highest Brinell hardness, or the highest tensile strength.

Actual experience has forced plant operators to make provisions for periodic repairs of pitted areas. It is common practice to rebuild the damaged parts by electric welding. First the honeycombed surface is chipped down to clean metal, a priming coat of low carbon steel is laid, and then surface finished with one or two layers of stainless steel, containing 18 per cent chromium and 8 per cent nickel. Then the surface is ground smooth, great care being taken to avoid irregularities and projections, since local pitting begins when water leaps over a hollow forming an unstable cavity.

The use of rubber in place of stainless steel has been quite successful where pitting has been only mild. Rubber appears to have the desired qualities to withstand the hammering of cavitation owing to its resiliency to impact, but methods of applying this material must be improved.

Rubber paint, as well as other materials, if applied often enough have kept runners from pitting, but only under mild conditions.

Much water has flowed by and much more will flow by before this problem of cavitation and subsequent pitting will have been satisfactorily answered. The economic significance of any improvement in turbine design or setting, or in the repairing of pitted runners, can well be realized when we consider the frequent occurrence of this phenomenon of cavitation.

Richard Khuen, Jr., Former Board Member, Dies

ON September 24 Richard Khuen, Jr., consulting engineer of Pittsburgh, Pa., died in that city at the age of 73. Mr. Khuen was born in Saginaw, Mich., and graduated from the University of Michigan in 1889. From 1893 to 1901 he was an engineer for the A. and P. Roberts Company, then a subsidiary of the Pencoyd Iron Works. In the latter year he began a long period of service with the American Bridge Company in Pittsburgh—from 1901 to 1914 as division engineer; from 1914 to 1931 as general manager of erection; and from 1931 to 1936 as chief engineer. For the past two years he had maintained a consulting practice.

Mr. Khuen had long been an active member of the Society, joining with the rank of Junior in 1891. He became an Associate Member in 1895 and a Member in 1898. He served a term as Director of the Society—from 1916 to 1918—and, at the time of his death, was the nominee on the First Ballot for Vice-President from Zone II.

Report of the Tellers on Second Ballot for Official Nominees

October 15, 1938

To the Secretary
American Society of Civil Engineers:

The tellers appointed to canvass the Second Ballot for Official Nominees report as follows:

For Vice-President, Zone II		
*Richard Khuen, Jr.	692	
*Ineligible because of death		
Chas. M. Reppert	1	
Void	1	
Total	694	
For Vice-President, Zone III		
Clyde T. Morris	309	
Theodore A. Leisen	256	
Charles B. Burdick	368	
James L. Ferebee	394	
Void	2	
Total	1,329	
For Directors, District 1 (Two to be elected)		
Harold M. Lewis	519	
H. W. Hudson	520	
Void	5	
Total votes	1,044	
Actual number of ballots received (1/2 above)	522	
For Director, District 4		
Sanford W. Sawin	201	
Void	0	
Total	201	
For Director, District 11		
Charles T. Leeds	264	
Void	6	
Total	270	
For Director, District 14		
Robert B. Brooks	177	
Edward R. Stapley	72	
Void	1	
Total	250	
For Director, District 15		
Edward S. Bres	236	
Void	0	
Total	236	
Ballots canvassed		3,059
Ballots withheld from canvass:		
From members in arrears of dues	75	
Without signature	48	
Total withheld	123	123
Total number of ballots received		3,182

Respectfully submitted,

RALPH H. MANN, *Chairman*

Bernard L. Weiner
Albert P. Loriot
Bernard Gaber
Edward N. Whitney

George R. Latham
A. C. Josephs
Joseph Fertik
Charles D. Thomas
Tellers

Chance and Choice in Engineering

A Concise Presentation of a Matter of Importance to the Entire Profession

By R. L. SACKETT, M. AM. SOC. C.E.

DEAN EMERITUS OF ENGINEERING, PENNSYLVANIA STATE COLLEGE; CHAIRMAN OF THE COMMITTEE ON STUDENT SELECTION AND GUIDANCE OF THE ENGINEERS' COUNCIL FOR PROFESSIONAL DEVELOPMENT

IT IS the business of the engineer to eliminate chance from his work so far as the applications of science will permit. At the same time, boys are taking a chance by choosing an engineering college course without knowing all the facts necessary to sound judgment. Schools, colleges, and the engineering profession should be concerned with reducing the chance of failure and contributing to certainty of success by a cooperative effort to help boys to understand the foundations for a sound choice.

What does engineering education ask of a prospective student?

First: A definite liking for and ability in mathematics, particularly in solving problems.

Second: A scientific curiosity and a deep desire to know why and how force, electricity, heat, and chemicals act and react as they do.

Third: An interest in drawing, doing things, making things, seeing through them, understanding mechanical, electrical, and other devices, an ability to see in three dimensions or visualization. This latter valuable aptitude is called by various fancy names such as "imagination," "creative imagination," seeing "special relations," "seeing things with eyes shut."

Fourth: Character, courage, a genuine ambition, supported by dogged determination and many other qualities are either necessary or helpful.

The boy who masters an engineering education has proved that he has capabilities for achievement not only in engineering but in other fields as well, as is attested by the careers of many successful men.

If an engineer is concerned that his profession should raise its standards, then he may begin by helping the home high schools to give ripe counsel so that able boys with the desirable interests will feel encouraged to apply for admission to an engineering college. Those who are attracted by the spectacular and romantic should understand the nature of the severe discipline ahead of them and make their decision with their eyes open to the realities.

If the engineer is really interested in taking chance out of the choice which boys sometimes take when selecting engineering for a career, the engineer will offer his services to his high school principal. Many local engineering societies are doing a good job. Local sections of the national societies can also help by organized effort.

Tennessee Valley Section Plans Three-Day Annual Meeting

AN interesting program has been arranged for the annual meeting of the Tennessee Valley Section, which will be held at the Andrew Johnson Hotel in Knoxville on November 10, 11, and 12. Thursday evening, when the meeting convenes, and Friday will be devoted to a discussion of several forms of organization for improving the economic status of the engineer, including the existing technical societies, the professional engineering societies, and a form of organization that might affiliate with organized labor. The annual banquet will take place on Friday night, and inspection trips to various projects of the Tennessee Valley Authority have been arranged for Saturday.

Appointments of Society Representatives

F. M. DAWSON, M. Am. Soc. C.E., has accepted an appointment as cooperating member of the Special Committee on Hydraulic Research.

E. M. T. RYDER, M. Am. Soc. C.E., will serve as one of the Society's representatives on Engineering Foundation for the term, October 1938–October 1940.

American Engineering Council

The Washington Embassy for Engineers, the National Representative of a Large Number of National, State, and Local Engineering Societies Located in 40 States

Invention and the Engineers' Relation to It

The second forum of American Engineering Council will be held in Detroit on November 11 at the Hotel Statler, with the Michigan Engineering Society acting as host. As earlier announced, the forums of American Engineering Council have a fundamental purpose, namely, to provide an opportunity for engineers to discuss with other public and professional men basic problems of primary engineering character, which have a public interest. The proceedings of the forum in compact form constitute the engineers' contribution to public questions discussed and are distributed to those in public authority, as expressions of opinion of engineers on these subjects.

The forthcoming forum will open with a luncheon, with greetings from the president of the Michigan Engineering Society, Dean H. B. Dirks, and response by Dr. William McClellan, president of American Engineering Council. Frederick A. Allner, chairman of American Engineering Council's Committee on Public Affairs, which is in general charge of forums, will also speak.

The detailed program on "Invention and the Engineers' Relation to It" is under the sponsorship of the A.E.C. Committee on Patents, of which R. S. McBride, consulting chemical engineer of Washington, D.C., is chairman. The specific discussion will begin with a presentation of the case for industry, under the heading, "Industry's Gains and Industry's Responsibilities," by Charles F. Kettering, vice-president of the General Motors Corporation. Mr. Kettering's talk will be discussed from several angles by representatives of Detroit industry. "The Place of the Government in Research" will be presented by Dr. Lyman J. Briggs, director of the National Bureau of Standards. Opportunity will again be given following Dr. Briggs' talk for discussion by representatives of industry and the government who have been invited to participate.

The evening session will open with a dinner, at which Harry H. Semmes, chairman of the American Bar Association Patents Survey Committee, will speak on the "Economic Aspects of the Patents Survey." He will be followed by Kenneth H. Condit, executive assistant to the president of the National Industrial Conference Board, who will discuss "The Relation of Patents and Invention to the American Industrial System." As in the afternoon session, invitations have been issued to many individuals to participate in the discussion and to bring out various phases of research in the development of new industries and the interrelation between patents and research in promotion of American enterprise.

Invitations will be extended not only to engineers resident in Detroit and the surrounding territory, but to representatives of industry, finance, and the other professions whose interests are allied to those of the engineers in the wider public understanding of this subject.

Further details with regard to the meeting can be secured by writing to either the Secretary of American Engineering Council at 744 Jackson Place, N.W., Washington, D.C., or to E. L. Brandt, Executive Secretary of the Michigan Engineering Society and Managing Secretary of the Engineering Society of Detroit, 272 Hotel Statler, Detroit, Mich.

Washington, D.C.
October 12, 1938

Society Badges for Christmas Gifts

It is sometimes hard to know what to give the men in one's family for Christmas. However, a Society badge provides an ideal solution to this problem, if the man in question is a member of the Society and does not possess another badge at the time. If he has never before had a badge the order will not be questioned. However, if he has had one and lost it, the order should be accompanied by a statement to that effect.

The badge for Honorary Members, Members, Associate Members, and Affiliates is blue enamel on solid 14-carat gold, the gold showing in the lettering and as a border around the shield. It costs $5, including the cost of engraving the member's name and grade of membership. The pin for Juniors is similar in shape and design, but is of 8-carat gold and has a white border. It costs $2. The pin for Student Chapter members is gold filled and costs a dollar. Like the Junior pins, it has a white border, but is maroon where the other pins are blue. The Junior and student pins are not engraved, but all pins have safety catches. Badges may be had in the form of fobs or charms for watch chains, if preferred.

The badges must be ordered by December 1, if delivery is desired before Christmas. All orders should be sent to Society Headquarters, 33 West 39th Street, New York, N.Y.

Society Offers Lantern Lectures to Students for Tenth Season

San Francisco–Oakland Bay Bridge

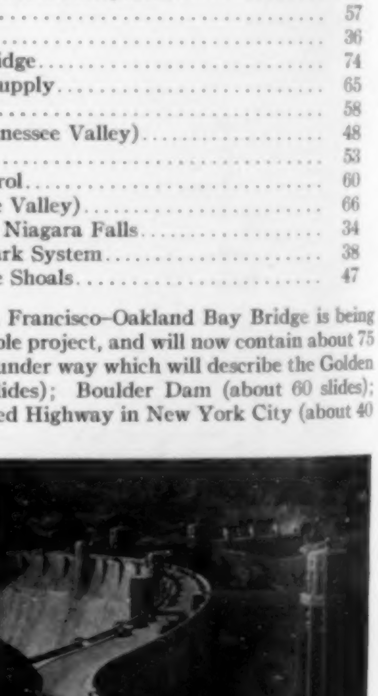
The current school year marks the tenth season in which the Society has offered to its Student Chapters certain material for their meetings, in the form of lantern slides with mimeographed descriptions, covering a number of important engineering projects. Both slides and lectures are sent to any Chapter without charge.

There have been 18 different titles in this series, all of which were used with profit last year. This year one of these lectures is being revised and much enlarged, and three entirely new subjects are being added to the list.

The lectures now ready, with the number of slides in each, are as follows:

Lectures	Slides
Aerial Photographic Mapping	59
Carquinez Strait Bridge	58
Cascade Tunnel	45
Catskill Water Supply	60
Conowingo Hydro-Electric Development	46
Coolidge Dam	57
Florianapolis Bridge	36
George Washington Bridge	74
Hetch Hetchy Water Supply	65
Holland Tunnel	58
Joe Wheeler Dam (Tennessee Valley)	48
Miami Flood Control	53
Mississippi Flood Control	60
Norris Dam (Tennessee Valley)	66
Power Development at Niagara Falls	34
Westchester County Park System	38
Wilson Dam at Muscle Shoals	47

The lecture on the San Francisco–Oakland Bay Bridge is being expanded to cover the whole project, and will now contain about 75 slides. New lectures are under way which will describe the Golden Gate Bridge (about 50 slides); Boulder Dam (about 60 slides); and the West Side Elevated Highway in New York City (about 40 slides). Reservations for the new lectures will be received for dates after November 15.



Boulder Dam

Reservations for slides should be made well in advance of the date when they are to be shown. Experience has proved that those who wait until the last minute have often been unable to obtain the particular lecture asked for.

News of Local Sections

Scheduled Meetings

Buffalo Section—Luncheon meeting at the Buffalo Athletic Club on November 8, at 12:15 p.m.

Central Ohio Section—Luncheon meeting at the Chittenden Hotel on November 17, at 12 m.

Dayton Section—Luncheon meeting at the Dayton Engineers Club on November 21, at 12:15 p.m.

Georgia Section—Luncheon meeting at the Atlanta Athletic Club on November 14, at 12:30 p.m.

Los Angeles Section—Dinner meeting (Ladies' Night) at the Foyer of Town and Gown, University of Southern California, on November 9, at 6:30 p.m.

Metropolitan Section—Technical Meeting in the Engineering Societies Building in New York City on November 16, at 8 p.m.

Mohawk-Hudson—Dinner meeting at the Hendrick Hudson Hotel in Troy, N.Y., on November 28.

North Carolina Section—Meeting at the King Cotton Hotel in Greensboro, N.C., on November 2, at 2:30 p.m.

Panama Section—Banquet and meeting on December 5.

Philadelphia Section—Joint meeting with technical and industrial engineering groups at the Bellevue-Stratford Hotel on November 9, at 2 p.m.; dinner at 7:00 p.m.

Sacramento Section—Regular luncheon meetings at the Elks Club every Tuesday at 12:10 p.m.

San Francisco Section—Dinner meeting of the Junior Forum at Hellwigs Restaurant on November 15, at 6:00 p.m.

Seattle Section—Dinner meeting at the Engineers Club on November 28, at 6:00 p.m.

Tennessee Valley Section—Annual meeting at the Andrew Johnson Hotel in Knoxville, Tenn., on November 10, 11, and 12.

Utah Section—Dinner meeting at the Beau Brummel Cafe on November 4, at 6:30 p.m.

Wisconsin Section—Joint dinner meeting with the University of Wisconsin Student Chapter at the Memorial Union Building in Madison, Wis., on November 8, at 6:30 p.m.

Recent Activities

Arizona Section

A dinner meeting of the Arizona Section took place in Phoenix on September 28, with 19 present. The principal speaker on this occasion was Raymond A. Hill, consulting engineer of Los Angeles and Director of the Society, who outlined the scope and purposes of the work of the Committee on Professional Objectives. Proposed legislation affecting the reorganization and rehabilitation of the Fort Grant Industrial School for boys was endorsed, following a report given by Vic H. Housholder, vice-president of the Section's legislative committee. A report on the possibility of employing a full-time paid secretary to represent the entire profession in Arizona concluded the evening. This was presented by W. T. Wishart, secretary of the Section.

Cincinnati Section

On October 4 the Cincinnati Section held a joint dinner meeting with the Dayton Section of the Society, the Student Chapters at the University of Cincinnati and the University of Dayton, and the Cincinnati Chapter of Professional Engineers and Surveyors. Short after-dinner speeches were given by Edward Larsen and E. B. Fauntleroy, who discussed the activities of the Cincinnati Chapter of Professional Engineers and Surveyors, and Field Secretary Jessup, who talked about Society affairs. The main speakers of the evening were then introduced. They were C. O. Sherrill and H. H. Kranz, respectively city manager and city engineer of Cincinnati. Both discussed different aspects of the Columbia Avenue Boulevard. The list of 125 present included 33 from Dayton.

Cleveland Section

A gathering of 60 members and guests of the Cleveland Section was present at the first luncheon meeting of the season, which took place on October 4. The program on this occasion aroused a great deal of interest, as it consisted of reports on engineering projects in Cleveland. The speakers in this symposium were Frank O. Wallace, director of public utilities; A. A. Burger, consulting engineer of Cleveland; and George B. Sowers, chairman of the Cleveland Port and Harbor Commission. Other interesting talks were given by Prof. M. S. Douglas, who reported the high lights of the Salt Lake City Convention, and S. G. Scoular, city engineer of Dunedin, New Zealand, who is visiting in this country.

Dayton Section

The first regular meeting of the Dayton Section took the form of a luncheon, which was held on September 19. After a brief discussion of business matters, an instructive technical talk on the enlargement of the Dayton sewage treatment plant was enjoyed. This was presented by M. V. Tatlock, superintendent, assisted by W. W. Morehouse, director. The attendance of 26 included five members of the University of Dayton Student Chapter. On October 4, a good-sized group went to Cincinnati to participate in the annual joint meeting with the Cincinnati Section. An account of this meeting appears under head of the Cincinnati Section.

District of Columbia Section

An inspection trip to the Naval Experimental Model Basin at Carderock, Md., proved of interest to 130 members and guests of the District of Columbia Section on September 17. Hugo Carl Fischer, lieutenant commander, C.E.C., U. S. Navy, was the officer in charge and received the guests. The fifth meeting of the Junior Forum of the Section took place at George Washington University on August 22. Among the guests was Clifford A. Betts, secretary of the Section, who outlined the forthcoming fall activities of the Section with the thought that members of the Junior Forum might want to attend. The speaker on the technical program was Alexander L. Redon, of the National Bureau of Standards, who presented a paper on navigation. Another meeting of the Junior Forum was held on September 26. On this occasion there was a talk by Dawes D. Brisbine, research counsel for the National Highway Users Conference, who discussed highway problems. At this session it was announced that a bowling team has been organized, and spirited competition with a Section team is anticipated.

Duluth Section

The Duluth Section was active during the summer months, holding several luncheon meetings. On June 20 the speaker was Peter E. Klein, district director of the Minnesota Hospital Service Association, who discussed the work of the organization in providing free hospitalization for its members on payment of a certain sum annually. The ninth annual golf tournament of the Section, following the luncheon held on July 18, was greatly enjoyed. The session on August 15 was largely devoted to business discussion, and on September 19 the guest of honor and speaker was Merle W. DeWees, secretary and engineer for the Duluth Taxpayers Association, who gave a talk on taxes and public improvement programs.

Illinois Section

The October 6 meeting of the Illinois Section was given over to a discussion of the proposed Illinois Engineering Council. After a talk by A. J. Hammond, Past-President of the Society, on the subject of the American Engineering Council, several members of the Section urged the formation of the Illinois Engineering Council. At the close of discussion the Section signified its willingness to join such an organization, and a constitution and by-laws were tentatively approved. There were 16 present. The Juniors of the Section opened the 1938–1939 season on September 26. After a short business session, Thomas Wilson, head of the Chicago office of the Engineering Societies' Employment Service, gave a talk on the functions of his office.

Kansas City Section

An excellent dinner, served to 22 members and guests of the Kansas City Section, preceded the September 29th meeting. An

interesting feature of the occasion was the presentation of a certificate of merit to Frank M. Cortelyou, Jr., alumnus of the University of Missouri and winner of the Section's 1937–1938 prize of junior membership in the Society. The speakers on the technical program were W. H. Bergwin and G. H. Palmer, both of the staff of the Missouri State Highway Department. The former discussed the development of superhighways around Kansas City, while Mr. Palmer's topic was "Organizing for Safety." During the evening music was furnished by Marie Roselli, harpist, with violin accompaniment.

Los Angeles Section

On September 14 the Los Angeles Section resumed its monthly meetings with a dinner meeting at the University Club. There were 136 present on this occasion to hear a fine technical program, consisting of talks by Harry Leypoldt, assistant civil engineer for the Los Angeles Harbor Department, and R. V. Labarre, consulting foundation engineer of Los Angeles. Mr. Leypoldt's topic was tidal datum planes, while Mr. Labarre discussed indications of progress in the study of earthquake phenomena. Following the latter talk, the Section authorized the appointment of a committee to study the possibility of establishing a foundation for research on earthquake-proof design and construction. The after-dinner speakers were H. W. Dennis, former Vice-President of the Society, and A. M. Rawn, president of the Section, who spoke on the Salt Lake City Convention.

Miami Section

The fall meeting of the Miami Section took place on October 13, with 15 present. During the business session a committee was appointed to make a study of the Miami port requirements. The speaker and guest of honor was Horace Andrews, member of the Section and former Director of the Society, who has just completed fifty years of membership in the Society. Mr. Andrews gave an enthusiastic talk on his pioneer work in Florida and as city engineer of Albany, N.Y. A dinner preceded the meeting.

Nashville Section

Eleven members of the Nashville Section were present at a dinner meeting, which was held in Kissam Hall at Vanderbilt University on October 4. After the transaction of routine business there was a talk by Fred J. Lewis, dean of the school of engineering at Vanderbilt University, who made special reference to the university's own program and the rating work of the E.C.P.D.

Panama Section

A meeting of unusual interest to the members of the Panama Section took place at the Union Club in Panama City on September 7. The speaker on this occasion was Edward S. Randolph, whose topic was studies and plans for the enlargement of the facilities of the Panama Canal. As designing engineer for the Panama Canal, Mr. Randolph is in direct charge of the studies undertaken by the special engineering section, which was created for that purpose, and his talk was very enthusiastically received. The usual business session completed the program, and refreshments and a social hour were then enjoyed. There were 40 present.

St. Louis Section

A talk on the European situation initiated the 1938–1939 activities of the St. Louis Section. This was given by Joseph C. Hail, former secretary of the G. L. Tarlton Company, at a luncheon meeting held on September 26. Mr. Hail's remarks, which were illustrated by colored motion pictures, were very timely, as he concentrated on Czechoslovakia and Austria. Because of wide interest in the Central European situation, there was the large attendance of 58.

Sacramento Section

Two special activities were enjoyed by the members of the Sacramento Section during September. On the 17th, about 40 made an inspection trip to the Mare Island Naval Station, where the navy is building a huge dry dock, and on September 27 there was a dinner meeting. George A. Sedgwick acted as toastmaster on the latter occasion and introduced the speakers—Raymond H. F. Boothe, of the California Division of Highways; K. M. Koch, of the General Electric Company; and Frederick E. Anderson, mechanical engineer in the U. S. Engineer office at Sacramento. There were 55 present. Speakers at the regular weekly luncheon meetings, which continued as usual, were Robert G. West, who spoke on the life of a midshipman at the U. S. Naval Academy at Annapolis, where he is a student; F. H. Frankland, chief engineer of the American Institute of Steel Construction; and Harold Conkling, deputy state engineer of water rights.

Seattle Section

There were 39 present at the first fall meeting of the Seattle Section, which took place at the Engineers Club on September 26. Following a brief business session, an illustrated lecture entitled "Problems in the Design of the Boeing Clipper" was enjoyed. This was given by John K. Ball and Ralph Cram, of the engineering staff of the Boeing Airplane Company. The former discussed the structural problems involved, while Mr. Cram explained the solution of hydrodynamic and aerodynamic problems with the aid of a model.

Spokane Section

About 12 members of the Spokane Section reported a pleasant informal luncheon with S. G. Scoular, city engineer of Dunedin, New Zealand, on September 9. There were 14 present at the regular meeting of the Section that took place on September 16. During the business session J. W. Howard gave a report on the Salt Lake City Convention. The main speaker of the evening was J. E. Buchanan, dean of engineering at the University of Idaho, who presented a paper on "Current Trends in Asphalt Technology."

Tacoma Section

The September meeting of the Tacoma Section was held at Longview, Wash., in an attempt to encourage the members who do not live near Tacoma or Olympia to attend. The result was an attendance of 18 members and 31 guests. Short talks were given by C. A. Mackmore, president of the Portland Section; Ross K. Tiffany, Director of the Society; and Merl Bassett. The speaker of the evening was then introduced. This was R. B. Wolf, manager of the pulp division of the Weyerhaeuser Timber Company, who described his recent trip through industrial plants in various European countries. His talk was illustrated by motion pictures that he had taken himself. The October meeting of the Section, which was held at the Lakewood Community Center in Tacoma, was attended by 25 members and 17 guests. The guest speaker was Royal N. Riblet, who described the mechanics of aerial tramways and exhibited models of tramway carriers, towers, a special ore-chute gate, and a ski-lift on runners that utilized an automobile motor and flexible cable.

Tennessee Valley Section

The Asheville Sub-Section of the Tennessee Valley Section initiated its autumn activities with a meeting on September 19. There were 35 present on this occasion to enjoy Dr. A. R. Cahn's colored motion picture of wild life in the Norris Dam area. Regular monthly meetings of the Chattanooga Sub-Section were resumed on September 20, when Walter Stromquist, sanitary engineer for the Tennessee Valley Authority, told the group about malaria control in the South. L. F. Bellinger, Vice-President of the Society, and H. L. Fruend, president of the Tennessee Valley Section, also spoke. The attendance was 31. During the past summer, members of the Knoxville Sub-Section enjoyed several inspection trips, under the guidance of James Goddard, chairman of the program committee. There were 70 present at the first regular monthly meeting, held on October 6. The speaker was T. P. Pendleton, of the Chattanooga office of the U. S. Geological Survey. The Muscle Shoals Sub-Section has held two joint meetings with the local branch of the American Institute of Electrical Engineers.

Wisconsin Section

There were 31 present at a meeting of the Wisconsin Section, held in Milwaukee on October 6. During the business session L. J. Larson, president of the Section, reported on the Local Section convention at Houghton, Mich., and various announcements were made. The speaker of the evening was Dr. Edgar End, of the Marquette University medical school. Dr. End, who has acted as technical adviser on research and experimental work on deep-sea diving, gave a very interesting talk on diving in general and the results of the experiments that may lead to greater safety in all work involving compressed air.

Student Chapter Annual Reports

For the School Year, 1937–1938

Alabama Polytechnic Institute

Weekly meetings were enjoyed by the members of the Alabama Polytechnic Institute Student Chapter during the past school year. On some of these occasions the faculty contributed a number of interesting talks, and on others the programs consisted of papers by students and outside guests and the presentation of the Society's illustrated lectures. During the course of the year H. H. Houk, head of the civil engineering department, conducted a number of week-end inspection trips to different parts of the state.

Brown University

During the past academic year the members of the Brown University Student Chapter have participated actively in both Chapter and Society affairs. The Chapter sponsored a joint meeting of the three engineering societies at the university and an illustrated lecture for the senior-class high school students in Providence. The response to the latter was so gratifying that the Chapter intends to make it an annual event. The entire Chapter attended the Fall Meeting of the Society in Boston, and in the spring participated in the formation of the New England Student Conference. The 20 regular meetings were principally closed sessions with programs consisting of discussions and papers presented by the members.

California Institute of Technology

A number of interesting inspection trips were enjoyed by the members of the California Institute of Technology Student Chapter during the past academic year. The new Union Depot under construction in Los Angeles and the Los Angeles plants of the American Concrete and Steel Pipe Company and of Fairchild Aerial Surveys, Inc., were among the places visited. In May the members enjoyed a special treat when, as guests of the Los Angeles Harbor Department, they took a boat trip around the harbor. During this excursion the financial and engineering problems of the harbor were explained. Two occasions of special interest were a luncheon for President Riggs, which took place in March, and the annual dinner for the Los Angeles Section, which was held on the campus of the Institute in May. In all there were nine meetings during the year, with a total attendance of 400.

Agricultural and Mechanical College of Texas

Students, members of the faculty, and outside speakers cooperated in preparing the programs for the 1937–1938 meetings of the Agricultural and Mechanical College of Texas Student Chapter. On the list of outside speakers were Field Secretary Jessup; R. F. Orth, of the Johns-Manville Corporation; Oscar A. Seward, Jr., newly appointed Contact Member for the Chapter; Mace H. Bell, division engineer for the American Institute of Steel Construction; President Riggs; and E. N. Noyes, Vice-President of the Society. In all there were 16 meetings, with a total attendance of 1,008. Delegates from the Chapter attended the Student Chapter conference held at the time of the Jacksonville Meeting of the Society.

Bucknell University

The annual report of the Bucknell University Student Chapter indicates that considerable progress was made in the past school year. There was a sizable increase in membership, and ten meetings were enjoyed. On some of these occasions the Society's illustrated lectures were shown, and on others there were faculty or guest speakers. Extra-curricular activities included a civil engineering exhibit and the annual spring picnic.

Carnegie Institute of Technology

The past school year was a banner one for the Carnegie Institute of Technology Student Chapter. Students presented a number of papers at the 30 meetings that were held, and there was also an imposing list of outside speakers. These included John W. Hackney, assistant hydraulic engineer for the Aluminum Company of America; H. G. Appel, design engineer for the Allegheny County Department of Public Works; William A. Conwell, structural engineer for the Duquesne Light Company; E. C. Hartmann, research engineer for the Aluminum Research Laboratories; C. F. Goodrich, chief engineer of the American Bridge Company; and Alexander Miller, district engineer of the American Institute of Steel Construction. Inspection trips to nearby places of engineering interest supplemented these sessions, and members of the Chapter attended several of the meetings of the Pittsburgh Section. There was full enrolment of those eligible.

Case School of Applied Science

The Case School of Applied Science Student Chapter reports the close of an excellent school year. There was 100 per cent enrolment of those eligible for membership, and the programs presented at the 13 meetings were made interesting and varied by alternating student, faculty, and outside engineers' talks. The list of the latter included A. L. Alin, chief designer for the Pittsburgh Flood Control Conservancy District; H. B. Carpenter, manager of the Corrigan-Republic Steel Corporation; and A. A. Burger, consulting sanitary engineer of Cleveland. On several occasions the Society's lantern slide lectures were also enjoyed. In March the Chapter entertained the freshmen and the members of the Cleveland Section at a Saint Patrick's Day dinner, and in May it was host at the annual joint meeting of the Section and the Student Chapters in the vicinity.

Members of the Agricultural and Mechanical College of Texas Student Chapter

Kansas State College

Students, members of the faculty, and outside speakers cooperated to make the past year an outstanding one for the Kansas State College Student Chapter. Among the guest speakers who addressed the 17 meetings were W. E. Baldry, Contact Member for the Chapter; Field Secretary Jessup; L. C. Crawford, of the Kansas State Department of Water Resources; and C. O. Parker, of the A. M. Beyers Steel Company. The Chapter sponsored the showing of several films and on one occasion presented a motion picture at a local theater, which was opened to the public free of charge. In October an inspection trip to places of interest in Chicago was enjoyed, and in April the Chapter acted as host to the Kansas State Section and the University of Kansas Student Chapter at a joint meeting and smoker. There was 100 per cent enrolment of those eligible for membership.

Senior Class Members of Kansas State College Student Chapter

Antioch College

The Antioch College Student Chapter has completed a well-rounded year of technical and social activities. There were 22 meetings, with a total attendance of 583. Students, members of the faculty, and outside speakers have all contributed to the success of these occasions. On the list of outside speakers were Arthur E. Morgan, at that time chairman of the Tennessee Valley Authority; Charles S. Bennett, Contact Member for the Chapter; O. E. Harder, assistant director of the Battelle Memorial Institute; and F. J. Hooven, consulting engineer. Films were shown through the courtesy of the Otis Elevator Company and the Westinghouse Electric and Manufacturing Company.

Catholic University of America

The Catholic University of America Student Chapter has completed an unusually successful school year. There was 100 per cent enrolment of those eligible for membership, and the programs for the regular semi-monthly meetings were devoted alternately to the Society's illustrated lantern lectures and to talks by students and practising engineers. The list of those who spoke included Ralph Berry, Contact Member for the Chapter; L. F. Bellinger, Vice-President of the Society; and Lt. O. S. Reading, of the U. S. Coast and Geodetic Survey. On several occasions special motion pictures were enjoyed through the courtesy of the Johns-Manville Corporation, the United Air Lines, and the National Lime Association. A number of inspection trips supplemented the regular meetings.

The Citadel

Although the Citadel Student Chapter was established in April, it had been functioning as The Citadel Engineering Society since January. During the one semester of its existence there were ten meetings, which attracted a total attendance of 423. Programs presented on these occasions consisted chiefly of student talks covering a variety of timely topics.

Clarkson College of Technology

There was 100 per cent enrolment of those eligible for membership in the Clarkson College of Technology Student Chapter during the past year. Some of the speakers at the six meetings that were held were Field Secretary Jessup; Charles McEllen, safety engineer for the Central New York Power Corporation; and W. T. Field, president and treasurer of The William T. Field Engineers, Inc., of Watertown, N.Y. Inspection trips included visits to the International Bridge under construction at Collins Landing, the water filtration plant of the city of Ottawa, Canada, and the sewage treatment plant of the city of Syracuse, N.Y. The latter trip was made in connection with participation in the Student Chapter conference held at Syracuse University.

Cooper Union

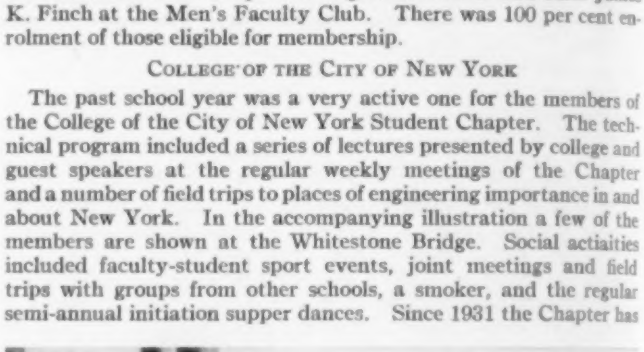
An incomplete report from the Cooper Union Student Chapter indicates that its 1937–1938 activities consisted of four regular meetings, with a total attendance of 175. Ole Singstad, chief engineer of the New York City Tunnel Authority, was one of the speakers heard at these sessions.

Columbia University

The Columbia University Student Chapter has completed a very successful year. In great part this was due to the enterprise of the students who prepared and presented a considerable number of papers at the meetings held during the year. Guest speakers included Robert Ridgway, Past-President of the Society, and Henry C. Tammen and Emil Praeger, consulting engineers of New York City. In addition to the 18 regular meetings, inspection trips were made to the Midtown Tunnel and to steel and cement plants at Bethlehem, Pa. Outstanding social events included a banquet celebrating the tenth anniversary of the founding of the Chapter and a dinner at which the members of the Chapter were guests of Prof. and Mrs. James K. Finch at the Men's Faculty Club. There was 100 per cent enrolment of those eligible for membership.

College of the City of New York

The past school year was a very active one for the members of the College of the City of New York Student Chapter. The technical program included a series of lectures presented by college and guest speakers at the regular weekly meetings of the Chapter and a number of field trips to places of engineering importance in and about New York. In the accompanying illustration a few of the members are shown at the Whitestone Bridge. Social actiaities included faculty-student sport events, joint meetings and field trips with groups from other schools, a smoker, and the regular semi-annual initiation supper dances. Since 1931 the Chapter has been editing a three-page mimeographed paper called the "Tech News," which contains news of the Society and the technology school in general. Many members of the Chapter are also on the editorial board of the "Vector," a new periodical recently issued by the school of technology.



Group from the College of the City of New York Student Chapter at the Whitestone Bridge Project

Cornell University

During the past academic year the Cornell University Student Chapter held eight meetings, which attracted a total attendance of 700. Except for one student paper, these sessions were all addressed by outside speakers. Among the latter were B. K. Hough, engineer in the U. S. Engineer Office at Ithaca; W. P. Creager, consulting engineer of Buffalo; E. D. Bickford, of the Bethlehem Steel Company; L. F. Agar, of the New York State Department of Health; Henry C. Tammen, consulting engineer of New York; and John C. Hussey, of the American Bridge Company. At several of the sessions J. W. Gaul, president of the Student Chapter,

gave reports on various Society and Student Chapter functions that he had attended.

Dartmouth College

Weekly meetings marked the 1937–1938 program of the Dartmouth College Student Chapter. Many of these sessions were given over to the presentation of papers prepared by members of the Chapter, and the writer of the paper adjudged the best was awarded the Thayer Society Prize of fifty dollars. This award went to Henry C. Beck, Jr., for his paper entitled "Labor and the Construction Industry." At some of the meetings guest speakers were heard, the list of these including George S. Fanning, chief engineer of the Erie Railroad, and C. F. Goodrich, chief engineer of the American Bridge Company. Social events included a fall outing and a baseball game and outdoor supper in the spring.

Drexel Institute of Technology

A special dinner initiated the 1937–1938 activities of the Drexel Institute of Technology Student Chapter. This was followed by monthly meetings, which were addressed by outside speakers, the list including Joseph A. de Luca, safety engineer for the duPont Dye Works; Samuel Sachs, lawyer; and Solomon M. Swaab, consulting engineer of Philadelphia. Members of the Chapter also enjoyed several interesting field trips. And special events included an engineers' ball and "civil engineers' day."

Duke University

The 1937–1938 report of the Duke University Student Chapter indicates that the 15 meetings held during the past year attracted a total attendance of 396. Students were responsible for a number of the programs presented on these occasions, and there were also several guest speakers.

George Washington University

An unusual number of interesting speakers were heard at the ten meetings held by the George Washington University Student Chapter during the past school year. These include L. C. Briggs, director of the National Bureau of Standards; C. A. Betts, secretary-treasurer of the District of Columbia Section; H. V. Darling, civil engineer of the Board of Engineers for Rivers and Harbors of the U. S. War Department; E. W. James, chief of the Division of Highway Transport of the U. S. Bureau of Public Roads; and Vice-President Bellinger. The annual engineers' ball was enjoyed in the spring, and at the end of the school year the members of the Chapter were guests of the District of Columbia Section.

Georgia School of Technology

The 1937–1938 report of the Georgia School of Technology Student Chapter indicates that there were 15 meetings, with a total attendance of 450. Members of the faculty and outside speakers were responsible for the programs on these occasions.

Harvard University

The Harvard University Student Chapter has completed an interesting and varied year. Among the speakers who addressed the 13 meetings were Dr. Miller McClintock, director of the Harvard Bureau for Street Traffic Research; Jonathan Jones, chief engineer of fabricated steel construction for the Bethlehem Steel Company; Dr. S. Timoshenko, of Stanford University; and Ole Singstad, chief engineer for the New York City Tunnel Authority. Throughout the year motion pictures were shown through the courtesy of different commercial firms, and on various occasions the members participated in Section and Society activities. In addition to several inspection trips to nearby places of engineering interest, members came to New York City in the spring for a six-day visit that included a number of inspection trips as well as a dinner at the Harvard Club where they were guests of the Harvard Engineering Society. Participation in the open house conducted by the graduate school concluded the year's activities.

Iowa State College

Since all juniors and seniors at Iowa State College must prepare papers in their required seminar courses, the Student Chapter made special efforts to secure outside speakers for most of the 11 meetings held during the past school year. The list included Neil Adams, of the Iowa State Highway Commission; A. J. Boase and E. W. Thorson, of the Portland Cement Association; O. W. Crowley, executive secretary of the Associated General Contractors of

Iowa State College Student Chapter Wins First Prize for Its Float in Annual Veishea Open House

America; and M. G. Spangler, associate structural engineer for the Iowa Engineering Experiment Station. In April the Chapter held its third annual spring banquet to welcome the freshmen who have chosen civil engineering for their profession. Each spring the senior civil engineering students devote a week to an inspection trip—generally to points of engineering interest in and about Chicago. As usual, the Chapter prepared the civil engineering and float exhibit for the annual all-college exposition, known as Veishea Open House. The accompanying photograph shows the float, which was awarded first prize.

Johns Hopkins University

The Johns Hopkins University Student Chapter boasted 100 per cent enrolment of those eligible for membership during the past academic year. A number of interesting speakers were scheduled for the meeting programs—among them L. F. Bellinger, Vice-President of the Society; Wallace L. Braun, traffic engineer for the city of Baltimore; and M. W. Loving, secretary of the American Concrete Pipe Association. Special motion pictures were enjoyed through the courtesy of the Shell Oil Company and the North American Cement Corporation. The nine regular meetings were augmented by a number of brief inspection visits to Baltimore projects and longer trips to other projects in Maryland and Pennsylvania. In April the Chapter went en masse to the University of Maryland for the third annual Maryland–District of Columbia Student Chapter Conference.

Lehigh University

Several interesting outside speakers were heard at the four regular meetings held by the Lehigh University Student Chapter during the past academic year. These included E. L. Durkee, assistant engineer for the Bethlehem Steel Company; C. E. Myers, Director of the Society and consulting engineer of Philadelphia; G. A. Rahn, Jr., research engineer for the Pennsylvania State Department of Highways; and Thaddeus Merriman, consulting engineer for the New York City Board of Water Supply. Special events included the annual inspection trip to places of interest in New York City, a Christmas banquet, and a spring outing.

Marquette University

Varied programs consisting of student talks, papers by outside speakers, and the Society's illustrated lectures were scheduled for the nine meetings sponsored by the Marquette University Student Chapter during the past academic year. Two of the outside speakers were Guy B. Skinner, superintendent of lighthouses, U. S. Lighthouse Service, and Dr. I. Edwards, of the Milwaukee Public Museum. Special activities included two banquets, an inspection trip to the Milwaukee sewage disposal plant, the annual bowling party, and a spring picnic.

Massachusetts Institute of Technology

A vigorous membership drive initiated the 1937–1938 season for the Massachusetts Institute of Technology Student Chapter. This drive culminated in attendance at the Fall Meeting of the Society, held in Boston in October. Members of the Chapter also attended the annual student night of the Boston Society of Civil Engineers. The outside speakers heard at the Chapter's own meetings were E. Sherman Chase, consulting engineer of Boston, and J. Stuart Crandall, president and chief engineer of the Crandall Dry Dock Engineers.

New York University

A membership drive initiated the year's activities of the New York University Student Chapter. At the 25 meetings held during the year several outside speakers were heard, the list including Enoch R. Needles, Director of the Society, and Arthur G. Hayden, Contact Member for the Chapter. In January the Chapter was host at a smoker for the Student Chapter members in the Metropolitan area. The speaker on the latter occasion was J. S. Dodds, professor of civil engineering at Iowa State College. Other special events included an inspection trip to the Sixth Avenue Subway under construction and attendance at meetings of the Metropolitan Section and at the Annual Meeting of the Society. The accompanying photograph shows the day members of the New York University Student Chapter in the testing laboratory.

Day Members of New York University Student Chapter

Lewis Institute

The outstanding event of the school year for the Lewis Institute Student Chapter was sponsoring the first Midwestern Student Chapter Conference. This two-day session, which was held at the Medinah Athletic Club in Chicago in May, attracted a group of 50 students and faculty from seven Student Chapters in midwestern engineering colleges. There were eleven regular meetings during the year and two smokers. Motion pictures were scheduled for a number of the meeting programs, and the Society's illustrated lectures proved very popular.

Louisiana State University

The past school year was a banner one for the Louisiana State University Student Chapter. Through the courtesy of various commercial firms several films were enjoyed at the nine meetings held during the year, while students and faculty members were also represented on some of the programs. Several inspection trips proved of value, and in January the members went to New Orleans for a joint meeting with the Tulane University Student Chapter. Perhaps the high light of the year was the Student Chapter banquet honoring Henry E. Riggs, President of the Society, and other notable engineers. The civil engineering exhibit prepared by the Chapter for the annual engineers' day was adjudged the most interesting on record.

Manhattan College

A number of inspection trips to places of engineering interest in and about New York made the past year interesting for the Manhattan College Student Chapter. On one occasion members of the Chapter were guests of the 102d Engineers, New York National Guard, for a basketball game, lecture, and supper, and on another they were guests of New York University Student Chapter for a lecture. There were seven regular meetings, with a total attendance of 203.

Michigan College of Mining and Technology

The Society's illustrated lectures formed the nucleus of entertainment at the 13 meetings held by the Michigan College of Mining and Technology Student Chapter during the past school year. Outside speakers heard at these sessions included E. C. Wenger, regional highway engineer of the Portland Cement Association; George Koronski, maintenance engineer of Gogebic County, Michigan; and E. D. Rich, director of the bureau of engineering of the Michigan Department of Health. Members of the Chapter took part in the winter carnival held by the college, entering a statue in the exhibition and a float in the parade. Both entries received honorable mention.

Michigan State College

Inspection trips, lectures, athletic events, and social occasions made the past year a memorable one for the Michigan State College Student Chapter. The 17 meetings, with the exception of a party and banquet, were held as part of a senior class seminar. The partial purpose of these seminar classes was to train the members in public speaking, and 45 such talks were given by the students during the year. Perhaps the outstanding meeting of the year was a joint banquet held with the Michigan Section of the Society and the officers of the University of Michigan Student Chapter. There was 100 per cent enrolment of those eligible.

Mississippi State College

There was complete enrolment of those eligible for membership in the Mississippi State College Student Chapter during the past school year. In all there were nine meetings, at which seven students gave talks on engineering subjects. The list of outside speakers also heard at these sessions included George Howard, junior engineer for the U. S. Waterways Experiment Station at Vicksburg; N. H. Howe, structural engineer of Memphis, Tenn.; and Nelson H. Rector, assistant state director of malaria control for the Mississippi State Board of Health. The Chapter took an active part in planning and preparing the first annual engineers' day held at Mississippi State College.

Newark College of Engineering

A number of interesting speakers addressed the 1937–1938 meetings of the Newark College of Engineering Student Chapter. These included Dr. W. P. Gregg, of the U. S. Weather Bureau; Seth G. Hess, chief engineer of the Interstate Sanitation Commission; Morris Goodkind, bridge engineer for the New Jersey State Highway Department; C. W. Dunham, assistant engineer for the Port of New York Authority; and A. D. Power, of the Radio Corporation of America. In addition to the ten regular meetings, there were several special functions, including a father-and-son banquet and a visitors' day. On the latter occasion the Chapter showed moving pictures of civil engineering projects. Members of the Chapter attended the Annual Meeting of the Society in New York and the Metropolitan Conference of Student Chapters at Rutgers University.

A Few Members of the Newark College of Engineering Student Chapter

Missouri School of Mines and Metallurgy

The Missouri School of Mines and Metallurgy Student Chapter has completed a successful year in point of both membership and activity. There was full enrolment of those eligible for membership, and the 16 meetings were notable for their fine programs. Among the guest speakers were C. L. Sadler, senior topographic engineer for the U. S. Geological Survey; E. C. L. Wagner, manager of the Missouri branch of the Associated General Contractors of America; John C. Hoyt, consulting hydraulic engineer for the U. S. Geological Survey; T. F. Collier, regional structural engineer for the Portland Cement Association; W. Scott Johnson, chief public health engineer for the State of Missouri; and L. H. Dodd, district engineer of the American Institute of Steel Construction

Members of the Chapter also enjoyed several field trips and special motion pictures, and they participated in the activities of both the St. Louis and Mid-Missouri Sections.

Montana State College

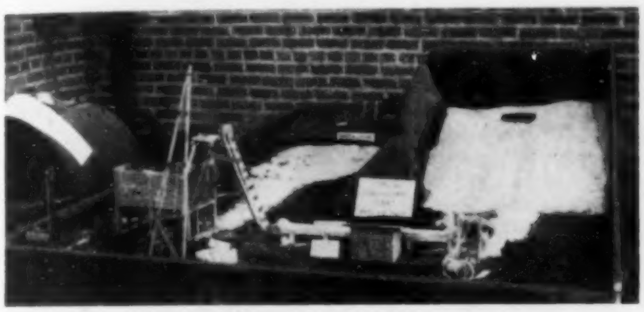
Student Chapter meetings at Montana State College during the past school year took the form of seminars—29 in all—at which the students presented a considerable number of papers. Other features enjoyed on these occasions were the Society's illustrated lectures. At a meeting held early in the fall Fred M. Brown, division engineer for the Montana State Highway Commission, was invited to be the first Contact Member for the Chapter. There was 100 per cent enrolment of those eligible for membership in the Chapter.

New Mexico State College (D. B. Jett)

A 3,500-mile field trip was the high light of the 1937–1938 activities of the New Mexico State College Student Chapter. This trip, which lasted two weeks, included visits to many points of engineering interest in Arizona, Colorado, and California, including Roosevelt, Coolidge, Morris, Parker, and Imperial dams; the All-American Canal; the Golden Gate and San Francisco–Oakland Bay bridges; and the Colorado River Aqueduct projects. Shorter trips—to Caballo and Conchas dams—were also made during the year. The Society's lantern slide lectures were enjoyed at a number of the 11 regular meetings, and there was one joint session with the New Mexico Section of the Society.

North Carolina State College

The North Carolina State College Student Chapter reports the close of the most successful year in its existence. There were 18 regular meetings, and in November the Chapter was host at a conference of Student Chapters in the state. A number of meetings were devoted to preparing exhibits for the engineers' fair, which was held in April. Several exhibits prepared by the Chapter, including methods of brick construction, were awarded prizes. One of the displays entered by the Chapter is shown in the accompanying illustration.



Model of Sand and Gravel Plant Exhibited by North Carolina State College Student Chapter

Oregon State Agricultural College

In addition to holding regular monthly meetings, it has for several years been the custom of the Oregon State Agricultural College Student Chapter to sponsor three breakfast meetings. These gatherings take place on Sunday mornings and are usually followed by an interesting talk. Those who addressed the sessions during the past year were C. B. McCullough, bridge engineer for the Oregon State Highway Commission; Father Delauney, dean of Portland University; and J. C. Stevens, consulting hydraulic engineer of Portland, Ore. Special activities included an inspection trip to Bonneville Dam and participation in the annual engineers' dance. One of the outstanding pieces of work accomplished by the Chapter was the establishment of a student loan fund for civil engineers.

Ohio State University

A drive for new members initiated the 1937–1938 activities of the Ohio State University Student Chapter, and a smoker, at which the new and prospective members were entertained, concluded the drive. Among the speakers at the ten meetings were S. S. Wyer, consulting engineer of Columbus, and C. E. Sherman, head of the department of civil engineering at the university. Special activities of the Chapter consisted of participation in the annual engineers' roundup and the biennial engineers' day celebration. For the latter occasion members of the Chapter took over the work of the civil engineering department in preparing a float for the parade and exhibits. The accompanying photograph shows one of the most interesting features of the exhibit—a model summer surveying camp set up in front of the exhibition hall.

Model of Summer Surveying Camp Displayed by Ohio State University Student Chapter in Biennial Engineers' Day Celebration

Norwich University

The Norwich University Student Chapter reports that during the past school year it held five meetings, with a total attendance of 175. On some of these occasions the Society's illustrated lectures were enjoyed, and on others there were speakers, including Lyle F. Bellinger, Vice-President of the Society.

Ohio Northern University

The Ohio Northern University Student Chapter announces the close of an unusually successful school year. Special occasions included attendance at the Ninth Annual District Convention held in Dayton, Ohio, in October, a number of field trips, several smokers, and an engineers' dance. Perhaps the high light of the year was engineers' week, which consists of meetings of the entire

Members of Oregon State Agricultural College Student Chapter

engineering college every day for a week, each Chapter acting as host once. Students presented a number of papers at the 14 regular meetings that were held, and there was 100 per cent enrolment of those eligible for membership.

Oklahoma Agricultural and Mechanical College

A number of interesting outside speakers addressed the 14 meetings held by the Oklahoma Agricultural and Mechanical College Student Chapter during the past academic year. Among these were B. S. Myers, consulting engineer of Oklahoma City; Chester B. Lewis, city engineer of Enid, Okla.; V. A. Rittgers, city traffic engineer of Oklahoma City; Harry F. Wahlgren, director of the U. S. Weather Bureau for the state of Oklahoma; W. R. Holway, consulting hydraulic engineer of Tulsa; and Field Secretary Jessup. In the spring the Chapter entertained the Oklahoma Section of the Society and the University of Oklahoma Student Chapter at a banquet.

Pennsylvania State College

Following its usual custom the Pennsylvania State College Student Chapter published a mimeographed sheet, entitled "The Tripod," each month during the past school year. Members of the faculty and outside speakers cooperated to make the 11 meetings a success. Among these speakers were B. F. Hastings, district engineer for the American Institute of Steel Construction; Lyle F. Bellinger, Vice-President of the Society; and George T. Seabury, Secretary. During the year membership in the Chapter increased from 31 to 58.

Polytechnic Institute of Brooklyn

An interesting innovation was tried by the Polytechnic Institute of Brooklyn Student Chapter during the past academic year when the Chapter was divided into two sections—one for the evening and one for the day students. For the first time, also, student talks, which had been built around the Society's lantern slide lectures, were enjoyed. On the list of other speakers were Robert Ridgway, Past-President of the Society and Contact Member for the Chapter; Charles Tucker, engineer for the Port of New York Authority; Frank H. Nowaczek, assistant engineer for the New York Board of Water Supply; Eugene L. Macdonald, associate engineer for Parsons, Klapp, Brinckerhoff and Douglas, of New York City; and Arthur G. Hayden, consulting civil engineer of New York. This program was supplemented by a number of field trips to places of engineering interest in and about New York. There was 100 per cent enrolment of those eligible for membership.

Purdue University

Both in point of membership and activity the Purdue University Student Chapter has completed an unusually successful year. Fine programs were enjoyed at the seven regular meetings, the list of guest speakers including M. R. Keefe, chief engineer of the Indiana State Highway Commission; Hallie Myers, Indiana state director of traffic; John W. Wheeler, engineer of highway negotiations for the Chicago, Burlington and Quincy Railroad; and Frank T. Sheets, president of the Portland Cement Association. In March the senior-class members of the Chapter were guests of the Indiana Section for a two-day inspection trip, and later in the spring the Chapter sponsored the annual banquet for the alumni and members of the faculty.

Pennsylvania Military College

Students, members of the faculty, and outside speakers cooperated in preparing the programs for the 1937–1938 meetings of the Pennsylvania Military College Student Chapter. Among the outside speakers who addressed the group were L. F. Bellinger, Vice-President of the Society, and S. S. Steinberg, dean of the college of engineering at the University of Maryland. On one occasion a motion picture depicting the building of the Golden Gate Bridge was shown through the courtesy of the Bethlehem Steel Company. Members of the Chapter attended several meetings of the Philadelphia Section of the Society, a series of lectures sponsored by the Engineers Club of Philadelphia, and the Student Chapter conference at the University of Delaware. There was 100 per cent enrolment of those eligible for membership.

Princeton University

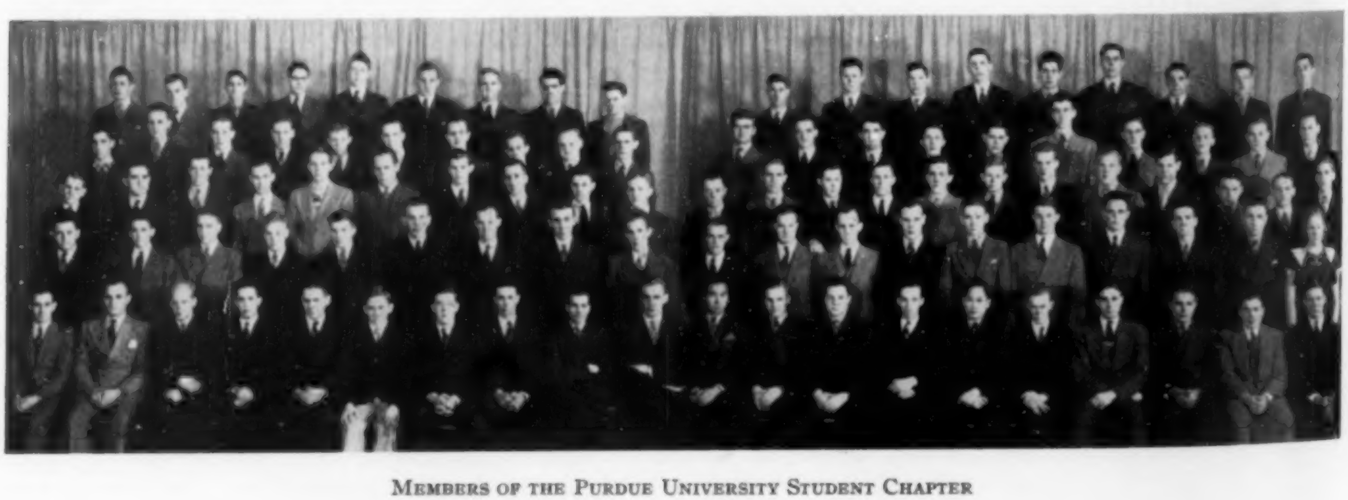
During the past school year the Princeton University Student Chapter held five meetings, with a total attendance of 215. The speakers at some of these sessions were Blair Birdsall, assistant engineer for the John A. Roebling's Sons Company; Alfred Rheinstein, commissioner of housing and buildings, New York City; and Lyle F. Bellinger, Vice-President of the Society. Special events included an inspection trip to the Trenton plant of the American Bridge Company, where the members saw the entire process of work on a bridge from the designing to the shipment of members.

Rensselaer Polytechnic Institute

Student participation in the 1937–1938 program of the Rensselaer Polytechnic Institute Student Chapter was emphasized. One of the seven regular meetings was devoted to the presentation of student papers, and interest was increased by the award of several small cash prizes. On another occasion an exchange student from Germany gave an illustrated lecture on the construction of superhighways in that country. At every session one of the Student Chapter officers spoke on the activities of the Chapter. At the Northeastern Conference of Student Chapters, held in Syracuse in the spring, Roy Purchase, president of the Chapter, was awarded first prize for the best paper presented at the conference.

Rhode Island State College

The Rhode Island State College Student Chapter announces the completion of an unusually successful year. The Chapter was host to a conference of the Student Chapters in New England and also sponsored an engineers' dinner for the other engineering groups at the college. To supplement their own meetings, members of the Chapter attended Society meetings in Boston, New York, and Providence. A number of interesting outside speakers addressed the 16 regular meetings. Among these were Waldo I. Kenerson and Frank Fahlquist, respectively chief of the soils laboratory and geologist at the U. S. Engineer Office in Providence; James L. Murray, Contact Member for the Chapter; Charles L. Pool, chief engineer for the Rhode Island State Department of Health; and

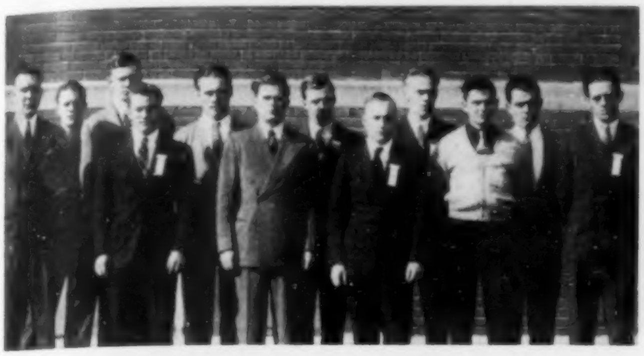


Members of the Purdue University Student Chapter

Henry Welles Durham, who is connected with the New York World's Fair.

South Dakota State School of Mines

Sponsorship of the first Student Chapter conference for the region comprising North Dakota, South Dakota, Montana, and Wyoming was the outstanding event of the 1937–1938 school



Delegates from South Dakota State School of Mines Student Chapter at Student Chapter Conference

season for the South Dakota State School of Mines Student Chapter. The Student Chapter delegates to the conference are shown in the accompanying photograph. Members of the Chapter also participate in editing "The Rapid Tech," a biweekly paper published during the school year by the South Dakota State School of Mines. The Society's illustrated lectures furnished the nucleus of entertainment at the ten regular meetings held during the year. There was 100 per cent enrolment of those eligible for membership.

Rice Institute

Among the outside speakers who addressed the seven meetings held by the Rice Institute Student Chapter during the past year were Field Secretary Jessup, President Riggs, and J. C. McVea, municipal improvements engineer of Houston, Tex. Perhaps the high light of the year was the engineering show, held on April 22 and 23. The civil engineering exhibit, sponsored by the Chapter, included demonstrations and explanations of all laboratory machines and other apparatus.

Stanford University

A number of interesting outside speakers were heard at the 18 meetings held by the Stanford University Student Chapter during the past year. These included Frederick H. Fowler, consulting civil engineer of San Francisco; President Riggs; Fred C. Scobey, senior irrigation engineer of the U. S. Department of Agriculture; and Edward Hyatt, state engineer of California. On one notable occasion members of the Chapter were guests at the home of former President Herbert Hoover, who discussed his recent trip to Europe. Through the courtesy of the Metropolitan Water District of Southern California, the Chapter was royally entertained on a three-day inspection tour of the Colorado River Aqueduct, which took place in March. A picnic supper and social gathering concluded the year's activities.

Rose Polytechnic Institute

There was full enrolment of those eligible for membership in the Rose Polytechnic Institute Student Chapter last year. The monthly meetings were addressed by several outside speakers, including C. K. Calvert, chief engineer of the Indianapolis Water Company; Henry Steeg, city engineer of Indianapolis; and G. R. Harr, bureau manager of the Highway Planning Survey of the U. S. Bureau of Public Roads. In October members of the Chapter were guests of the Indiana Section on an inspection trip that covered the steel plants in Gary and the bridges and sewage-treatment plants in Chicago. In February they went to Knoxville to visit the various projects of the Tennessee Valley Authority.

South Dakota State College

A number of interesting activities marked the 1937–1938 school year for the South Dakota State College Student Chapter. These included participation in the parade and festivities incident to South Dakota State College Homecoming Day, the engineers' ball, an engineers' picnic, and an all-school dramatic performance. The eight regular technical meetings were followed by luncheons served in the civil engineering laboratory, which gave the students an opportunity to get acquainted with each other and the members of the faculty.

State University of Iowa

Most of the programs presented at the 26 meetings held by the State University of Iowa Student Chapter during the past year were devoted to short talks by the members, supplemented with lectures by outside speakers. Several of the sessions took the form

Members of State University of Iowa Student Chapter

of joint meetings with other Student Chapters. The Chapter sponsored the preparation of civil engineering exhibits for the annual open house held each spring for the benefit of high school students visiting Iowa City. Attendance at the midwestern conference of Student Chapters, which was held at Lewis Institute in Chicago, climaxed the year's activities. There was full enrolment of those eligible. Members of the Chapter are shown in the accompanying photograph.

Members of the Stanford University Student Chapter

Swarthmore College

Students took an active part in the affairs of the Swarthmore College Student Chapter during the past school year by presenting a number of papers at the meetings that were held. On one occasion the speaker was George W. Lewis, director of aeronautical research of the National Advisory Committee for Aeronautics, who discussed the wind-tunnel tests, the experimental canal, and other research equipment in aerodynamics and hydraulics. The other outside speakers were Vice-President Bellinger and a representative of the Bethlehem Steel Company. In all there were eight meetings, with a total attendance of 310.

Syracuse University

Students, members of the faculty, and outside speakers cooperated to make the 1937–1938 meetings of the Syracuse University Student Chapter a success. On the list of the latter were Field Secretary Jessup and William C. Perkins, of the Eastern Brick Paving Association. On several occasions special motion pictures were enjoyed, and in the spring the Chapter was host to the second annual Northeastern Regional Student Conference.

Texas Technological College

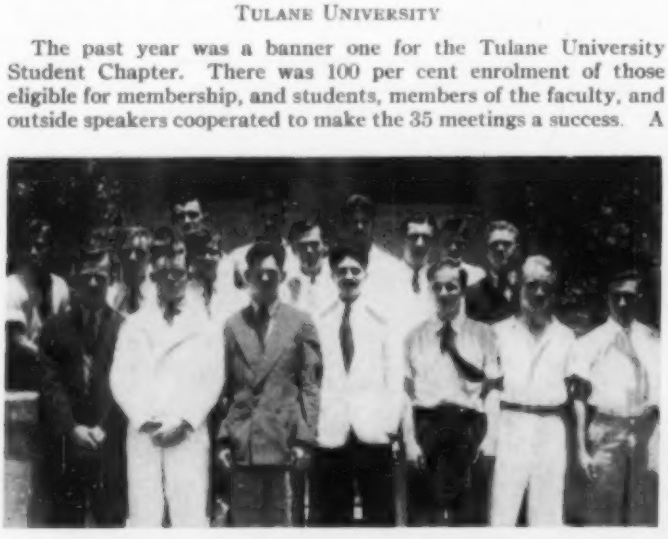
The eight meetings held by the Texas Technological College Student Chapter during the past year were in the hands of students, who prepared and presented 12 papers on a variety of timely topics. The Chapter also sponsored a series of lectures on irrigation engineering, which proved of great interest as the curriculum does not provide such a course. Special activities included the preparation of an extensive exhibit for the annual engineers' show, which was held in April, and a two-day inspection trip to the Conchas Dam Project at the mouth of the Conchas River in New Mexico.

Tufts College

A number of interesting activities supplemented the six regular meetings held by the Tufts College Student Chapter during the past academic year. Members of the Chapter attended the Fall Meeting of the Society in Boston and the Annual Meeting in New York City and made inspection trips to various places of engineering interest in New England. Senior-class members of the Chapter also attended a series of six lectures on moment distribution given by the Portland Cement Association at Massachusetts Institute of Technology. The list of outside speakers at the regular meetings included Harrison P. Eddy, Jr., consulting engineer of Boston, and E. B. Roberts, hydrographic and geodetic engineer for the U. S. Coast and Geodetic Survey.

Tulane University

The past year was a banner one for the Tulane University Student Chapter. There was 100 per cent enrolment of those eligible for membership, and students, members of the faculty, and outside speakers cooperated to make the 35 meetings a success. A number of these meetings took the form of inspection trips to places of engineering interest in and about New Orleans, including the Bonnet Carré Spillway and the Mississippi River Bridge at Baton Rouge. On each occasion some engineer familiar with the work supplemented the visit with a descriptive lecture. In May the college of engineering held its third annual field day for the purpose of interesting New Orleans high school students in civil engineering. Field day was inaugurated two years ago by the Tulane University Student Chapter, but it has since been extended to cover the whole engineering college. A group of members of the Chapter is shown in the accompanying photograph.



GROUP OF MEMBERS OF TULANE UNIVERSITY STUDENT CHAPTER

Union College

The Union College Student Chapter reports full enrolment of those eligible for membership in the past school season. The year's program got off to a good start with the annual picnic held at Prof. W. C. Taylor's farm. Among the speakers heard at the eight regular meetings were Harold V. Gulick, of the American Locomotive Company, and Prof. H. O. Sharp, of the Rensselaer Polytechnic Institute engineering faculty. In April the Chapter sponsored the showing of a motion picture depicting the construction of the Golden Gate Bridge, which was furnished by the Bethlehem Steel Company. Members of the local engineering societies and of the other student groups at the college were guests of the Chapter on this occasion.

University of Akron

Students presented papers at two of the three meetings held by the University of Akron Student Chapter during the past school year. At the other meeting the speaker was Alexander Miller, district engineer of the American Institute of Steel Construction, who gave an illustrated lecture on the "City of the Future." Special activities included an inspection trip through the Barberton Disposal Plant and attendance at a joint dinner meeting held at the Case School of Applied Science.

University of Alabama

A number of special motion pictures were enjoyed at the 1937–1938 meetings of the University of Alabama Student Chapter. On other occasions there were talks by outside speakers—among them E. E. Michaels, manager of the Birmingham plant of the Chicago Bridge and Iron Company; Joseph Cotlin, of the American Cast Iron Pipe Company; W. N. Woodbury, division engineer of the Virginia Bridge and Iron Company; and H. H. Hendon, sanitary engineer of Jefferson County, Alabama. In April there was a special meeting in honor of Henry E. Riggs, President of the Society, and George T. Seabury, Secretary. Both discussed the aims and activities of the Society. In all there were 12 meetings with a total attendance of 449.

University of Arizona

The University of Arizona reports that, despite its geographical isolation from other student groups, it has completed a very successful year. In the fall members of the Chapter went to Phoenix, where they were guests of the Arizona Section at a joint meeting, and in the spring they returned this hospitality by being host to the Section at an all-day technical session followed by a dinner meeting. Students presented a number of papers at the ten regular meetings, and several interesting outside speakers were also heard. The latter included Earle V. Miller and R. A. Hoffman, respectively engineer of plans and bridge engineer for the Arizona State Highway Department; Robert L. Sackett, dean emeritus of engineering at Pennsylvania State College; and J. E. Buchanan, research engineer for the Asphalt Institute. There were two dances during the year, and the Chapter exhibited a detailed set of models on road construction at the traditional St. Patrick's Day celebration.

University of Arkansas

Students were largely responsible for the success of the 16 meetings held by the University of Arkansas Student Chapter during the past school year. On these occasions they prepared and presented 33 papers, which covered a wide range of subjects. Several field trips to places of engineering interest in the state supplemented these meetings, and in May members of the Chapter attended the two-day session of the Mid-South Section of the Society, which was held in Little Rock. The annual banquet concluded the year's activities.

University of Delaware

There was 100 per cent membership in the University of Delaware Student Chapter during the past school year. Among the speakers heard at the six regular meetings were Vice-President

UNIVERSITY OF DELAWARE STUDENT CHAPTER IS HOST TO STUDENT CONVENTION

Bellinger; F. M. Graham, assistant engineer of standards for the Pennsylvania Railroad; W. J. Mayer, commercial research engineer for the Reading Iron Company; and W. C. Perkins, of the Eastern Paving Brick Association. In April the Chapter was host to the fourth annual Student Chapter convention. The delegates attending are shown in the accompanying photograph.

University of Cincinnati

The technical programs presented at the 1937–1938 meetings of the University of Cincinnati Student Chapter were largely in the hands of members of the faculty, who presented several talks of interest to the young engineer. On one occasion there was a joint session with the Cincinnati Section of the Society, the speaker being C. O. Sherrill, city manager of Cincinnati. There was full enrolment of those eligible for membership.

University of Colorado

Following its usual custom, the University of Colorado Student Chapter sponsored the presentation of a number of student papers at its 1937–1938 meetings. At some of these 16 sessions outside speakers were also heard, the list of these including G. Meredith Musick, Denver architect; Franklin K. Matejka and Martin Seiler, assistant engineers with the U. S. Bureau of Reclamation, and Porter J. Preston, engineer for the Bureau; Roy C. Gowdy, Vice-President of the Society; and Herbert S. Crocker, Past-President of the Society. Special events included a joint meeting with other student groups and an all-day inspection trip to places of interest in Denver. The latter event was followed by a dinner with the Colorado Section of the Society. Members of the Chapter also enjoyed the thirty-fifth annual engineers' "apple fest"—an evening of games, athletic contests, and refreshments.

University of California

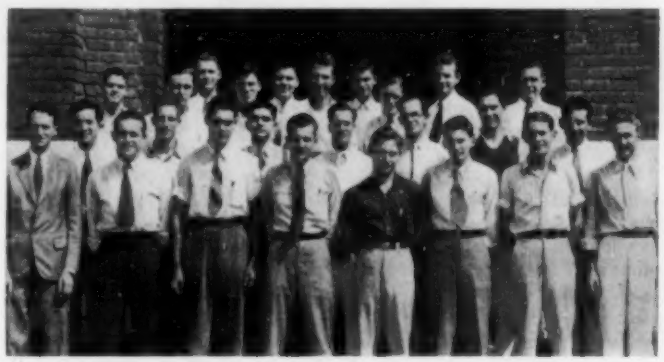
A joint rally, attended by more than five hundred students, initiated the most successful year in the history of the University of California Student Chapter. Later in the fall an inspection trip to the site of the 1939 Golden Gate International Exposition was enjoyed. Some of those making the trip are shown in the accompanying photograph. A new and highly successful project was a monthly publication entitled the "Techni-Cal," which was sponsored by the Chapter and distributed free to the members. In addition to eight regular meetings, members of the Chapter attended a number of the meetings of the San Francisco Section of the Society. Among the outside speakers heard during the year were James Ballard, editor of *Western Construction News*, and President Riggs.

University of Dayton

A number of student papers were scheduled for the programs presented at the 1937–1938 meetings of the University of Dayton Student Chapter. The Society's illustrated lectures also proved popular, and on several occasions there were outside speakers. In March the Chapter was honored by the Dayton Section with a dinner at the Engineers Club, the occasion being the selection of the Chapter as one of the twelve most active during the preceding school year. A number of field trips to projects of interest in and about Dayton and to the projects of the Miami Conservancy District augmented the 15 regular meetings.

University of Florida

The most important undertaking of the University of Florida Student Chapter during the 1937–1938 school year was sponsoring the highly successful Student Chapter conference, which was held at the time of the Jacksonville Meeting of the Society. Members



MEMBERS OF THE UNIVERSITY OF FLORIDA STUDENT CHAPTER

of the Chapter also prepared a number of outstanding and novel exhibits for the annual engineers' fair and competed in the activities of engineers' day, winning first place in some of the athletic events. There were 11 regular meetings, with students and outside speakers appearing on the technical programs. The list of the latter included G. F. Schlesinger, chief engineer and managing director of the National Paving Brick Manufacturers' Association, and C. R. Bloxton, district engineer of the American Institute of Steel Construction. The members of the Chapter are shown in the accompanying photograph.

MEMBERS OF UNIVERSITY OF CALIFORNIA STUDENT CHAPTER VISIT SITE OF 1939 INTERNATIONAL EXPOSITION

University of Illinois

The University of Illinois Student Chapter reports the close of another successful school year. Members have especially enjoyed the Student Chapter office and this year set aside a fund for new

Section of Wall in Student Chapter Office at University of Illinois

furniture. A mural of all the colored posters used to advertise speakers for the past few years decorates one of the walls, and the accompanying photograph gives an idea of the effectiveness of this decoration. Each semester an interesting miniature newspaper devoted to past and future Chapter activities and known as "The Illini A.S.C.E." was issued. The list of guest speakers at the 15 meetings included the late J. A. L. Waddell and L. F. Harza, consulting engineers; Harland Bartholomew, city planner; John C. Page, commissioner of the U. S. Bureau of Reclamation; Louis C. Hill, then President of the Society; Arthur Casagrande, of the Harvard University graduate school; and A. E. Cummings, district manager for the Raymond Concrete Pile Company.

University of Louisville (The Intrados)

The newly formed University of Louisville Student Chapter, an outgrowth of the engineering society called "The Intrados," reports the close of a successful school year. Most of the 19 meetings were notable for the presentation of student papers, which were well prepared and covered a variety of timely topics. Inspection trips were made to construction and bridge engineering projects in Kentucky and to the Speed Cement Plant at Speed, Ind. In March members of the Chapter attended a joint meeting of the Kentucky Section of the Society and the Engineers and Architects Club, and in May they were guests of the University of Kentucky Student Chapter at the annual banquet for the Kentucky Section.

University of Maine

Several outside speakers addressed the eight meetings held by the University of Maine Student Chapter during the past academic year. Among these were David Landon, of the U. S. Geological Survey; Henry L. Doten, Contact Member for the Chapter; and Earl Bennett, of the Maine State Highway Department. Special events included a field trip to see an actual demonstration of settling a highway fill in swamp with dynamite, and attendance at the Conference of the Maine Association of Engineers.

University of Maryland

During the past academic year the University of Maryland Student Chapter, for the first time, sponsored various social events. These included a hike, a picnic, and the first annual engineers' ball. The Chapter also acted as host to the third annual Maryland–District of Columbia Student Chapter conference. The ten regular meetings held during the year attracted an attendance of 262. On several occasions the Society's lantern slide lectures were enjoyed, while on others there were student and guest speakers.

University of Detroit

Although the University of Detroit Student Chapter has functioned as such only since April, the 1937–1938 record of the Civil Society, from which the Chapter was developed, is very praiseworthy. There were eight regular meetings, four inspection trips, and a special banquet to enable the younger men to become acquainted with the alumni. Among the outside speakers who appeared on the technical programs were N. Miller, of the S. A. Healy Company; Joseph A. Fox, engineer of city control, City of Detroit; William H. Adams, supervising engineer for the inspection division of the PWA; and Alexander Miller, district engineer for the American Institute of Steel Construction. There was full enrolment of those eligible for membership.

University of Kentucky

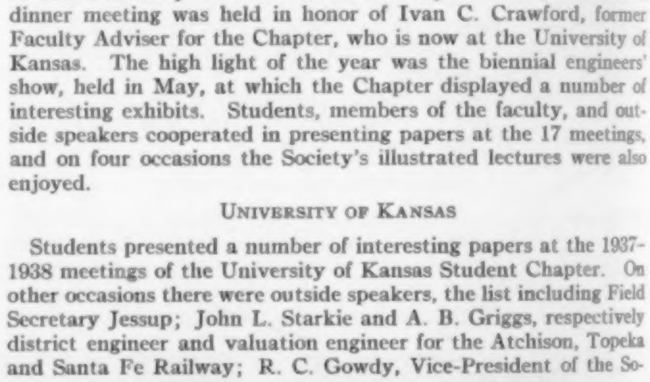
Weekly meetings were enjoyed by the members of the University of Kentucky Student Chapter during the past academic year. The student papers presented on these occasions were supplemented by talks by members of the faculty and outside speakers. Of special interest was a two-day inspection trip to the projects now under construction by the Tennessee Valley Authority. A fitting conclusion to the year's activities was a joint dinner meeting of the Chapter, the Kentucky Section of the Society, and the University of Louisville Student Chapter, which took place in May. J. E. Root, Director of the Society, was one of the after-dinner speakers on this occasion. The banquet and program were followed by a very successful dance, sponsored by the Chapter. There was full enrolment of those eligible for membership.

University of Idaho

A picnic and afternoon of sports initiated the 1937–1938 program of the University of Idaho Student Chapter. In November a dinner meeting was held in honor of Ivan C. Crawford, former Faculty Adviser for the Chapter, who is now at the University of Kansas. The high light of the year was the biennial engineers' show, held in May, at which the Chapter displayed a number of interesting exhibits. Students, members of the faculty, and outside speakers cooperated in presenting papers at the 17 meetings, and on four occasions the Society's illustrated lectures were also enjoyed.

University of Kansas

Students presented a number of interesting papers at the 1937–1938 meetings of the University of Kansas Student Chapter. On other occasions there were outside speakers, the list including Field Secretary Jessup; John L. Starkie and A. B. Griggs, respectively district engineer and valuation engineer for the Atchison, Topeka and Santa Fe Railway; R. C. Gowdy, Vice-President of the So-



Model of Suspension Bridge Displayed by University of Kansas Student Chapter in Biennial Engineering Exposition

ciety; and Jack Singleton, engineer for the American Institute of Steel Construction. Special activities included inspection trips to several bridge and dam projects and participation in the biennial engineering exposition. Student Chapter exhibits in the latter included models of clover-leaf highway intersections, water purification plants, and bridges. The accompanying photograph shows one of the bridge models.

University of Michigan

Ten talks by members of the faculty were enjoyed by the University of Michigan Student Chapter during the past academic year. Outside speakers heard at the 12 sessions were President Riggs; W. H. Adams, supervising engineer for the PWA at Detroit, Mich.; and Louis E. Ayres, Director of the Society. Special events enjoyed during the year were smokers, spring and fall initiation banquets, and inspection trips to places of engineering interest in Detroit and Ann Arbor.

University of Minnesota

A get-together smoker in the first week of school initiated the 1937–1938 program of the University of Minnesota Student Chapter. In all, there were 13 meetings with a total attendance of 1,200. At two of these sessions there were outside speakers—Hibbert M. Hill, Contact Member for the Chapter, and Otis E. Hovey, Treasurer of the Society—and on other occasions the Society's lantern slide lectures were enjoyed. Special events included the annual social meeting, an inspection trip to the Twin City sewage disposal plant, and a joint meeting with the Northwestern Section of the Society. The annual Chapter picnic concluded the year's activities.

University of Mississippi

The University of Mississippi Student Chapter reports the close of one of the most enjoyable years in its existence. In addition to student and faculty speakers who addressed the 14 meetings, there were a number of outside speakers. The list of these included L. L. Hidinger, Director of the Society; F. V. Ragsdale, new Contact Member for the Chapter; Maj. C. S. Johnson, of the Reserve Officers Training Corps; and N. H. Rector, assistant state director of malaria control for the Mississippi State Board of Health. On several occasions motion pictures were enjoyed, and special activities included sponsoring a Christmas dinner and dance and an inspection trip to the projects being constructed by the Tennessee Valley Authority.

University of Missouri

Eight meetings—with a total attendance of 269—were held by the University of Missouri Student Chapter during the past academic year. The list of speakers addressing these sessions included representatives of several commercial firms and some of the faculty members. On one occasion members of the Chapter went to St. Louis where they were guests of the St. Louis Section of the Society for an inspection trip.

University of Nevada

The University of Nevada Student Chapter reports the close of an exceptionally good year, considering its small membership. There were nine regular meetings, with a total attendance of 210, and several trips. Some of these trips were made possible through the courtesy of C. L. Hill, Contact Member for the Chapter, who accompanied the members and helped provide transportation for them. On the list of speakers were Harry C. Dukes, water master for the Truckee River Basin; George Hardman, who gave a talk on the relationship of tree rings to yearly precipitation; and Jack Smith, Frank Howland, and Leo J. Foster, of the U. S. Bureau of Reclamation. Special motion pictures were enjoyed through the courtesy of the U. S. Pipe and Foundry Company and the John A. Roebling's Sons Company.

University of New Hampshire

The University of New Hampshire Student Chapter boasted 100 per cent enrolment of those eligible for membership in the past school year. Students presented 52 papers at the 21 meetings that were held. On several occasions outside speakers were also heard, the list of these including George E. Martin, consulting engineer for the Barrett Company, of New York City; A. M. Fink, of the A. M. Byers Company; and LeRoy F. Johnson, Contact Member for the Chapter. Social events included a smoker.

University of North Dakota

Members of the University of North Dakota Student Chapter played an active part in making the past school year a successful one for the Chapter. They spent several months, for instance, in preparing exhibits for the annual engineers' day open house. Their main display was a contour map showing the drainage area of the Missouri River Diversion Project, which attracted a great deal of attention. Another special activity was a field trip, which took in places of engineering interest in and about Minneapolis, Minn In all there were nine meetings, with a total attendance of 118.

University of Oklahoma (Stadia Club)

Members of the University of Oklahoma Student Chapter inaugurated a new policy of presenting a number of student talks at the eight meetings held during the 1937–1938 school year. They also played an active part in making the annual open house sponsored by the civil engineering school a success, their exhibits including a dam model showing seepage lines, a model lock and dam, and a model of improved highway intersections. Among the outside speakers heard during the year were John Milligan, efficiency engineer for the Oklahoma State Board of Public Affairs; C. E. Bretz, former city engineer of Oklahoma City; and Victor H. Cochrane, consulting engineer of Tulsa, Okla.

University of Pennsylvania

Members of the University of Pennsylvania Student Chapter enjoyed a number of the regular monthly meetings of the Philadelphia Section during the past year. A group from the Chapter also participated in the joint Student Chapter Conference held at the University of Delaware, at which R. C. Lipman, a member of the Chapter, was awarded a prize for his paper on "Electrification Work on the Pennsylvania Railroad." Although so many members of the Chapter commute that it was not found advisable to schedule regular evening meetings, the Chapter arranged one interesting evening gathering, which was attended by guests from neighboring Student Chapters. The speaker at this session was L. F. Bellinger, Vice-President of the Society.

University of Pittsburgh

Interesting and varied programs were arranged for the 1937–1938 activities of the University of Pittsburgh Student Chapter. Students spoke at four of the 27 meetings, and the speakers for the other occasions were members of the faculty and practicing engineers. Some of the latter were Prevost Hubbard, chemical engineer for the Asphalt Institute; Frank Roessing, director of public works for the city of Pittsburgh; Andy Hevins, research engineer for the Kopper Tar Products Company; J. S. Lambie, an engineer for the Concrete Products Company; and L. W. McIntyre, executive vice-president of the Pittsburgh Motor Club. On several occasions films were shown through the courtesy of the Bureau of Mines in Pittsburgh. Members of the Chapter also attended many of the meetings of major engineering groups in Pittsburgh. There was full enrolment of those eligible.

University of Santa Clara

The University of Santa Clara Student Chapter, which was established in April, made an auspicious start with 100 per cent enrolment of those eligible for membership. There were two business meetings and an inspection trip to the Pittsburg (Calif.) plant of the Columbia Steel Company. The engineering organization out of which the Chapter was formed had an active year, with bimonthly meetings and inspection trips.

University of South Carolina

An incomplete report from the University of South Carolina Student Chapter indicates that there were 16 meetings last year, with a total attendance of 240.

University of Southern California

Varied programs were presented at the 1937–1938 meetings of the University of Southern California Student Chapter. On several occasions the Society's lantern slide lectures were shown, and there were also student papers and talks by outside speakers. In addition to semimonthly meetings, several inspection trips were enjoyed. There was also an interesting innovation in the form of a symposium, in which prominent engineers representing several civil engineering fields gave talks and answered questions. Social activities included special luncheons and athletic competitions with other engineering societies on the campus.

University of Tennessee

An incomplete report from the University of Tennessee Student Chapter indicates that there were 12 meetings during the year with a total attendance of 150. Entertainment on these occasions was

furnished by student, faculty, and guest speakers, and by the showing of the Society's illustrated lectures.

University of Texas

The past was a banner year for the University of Texas Student Chapter. Students, members of the faculty, and outside speakers cooperated in the programs presented at the 18 meetings. The list of outside speakers included Field Secretary Jessup; A. C. Love, resident engineer for the Texas State Highway Department; A. S. Stiles, engineer for the Pure Oil Company, of Austin, Tex.; and Dick Vaughan, Scripps-Howard news representative. One of the high lights of the year was the annual power show, for which the Student Chapter arranged a very comprehensive civil engineering exhibit. Other activities that were especially enjoyed were a get-together meeting in the fall, an engineers' dance, a Christmas party, and several field trips.

University of Utah

The illustrated lectures furnished by the Society formed the nucleus of entertainment at the 11 meetings held by the University of Utah Student Chapter during the past school year. At other sessions students and members of the faculty spoke. In the spring a series of five interesting field trips supplemented the regular program of the Chapter, the places visited including the open-pit copper mine of the Utah Copper Company at Bingham, Utah, and Echo and Pine View dams. Social events included a party at the Great Salt Lake Yacht Club, where the members were guests of Dr. Thomas C. Adams, and a picnic in Emigration Canyon. Members of the Chapter are shown in the accompanying photograph.

Members of the University of Utah Student Chapter

University of Vermont

Regular monthly meetings were enjoyed by the University of Vermont Student Chapter during the past academic year. In addition to student papers, several talks were given by outside engineers, including Field Secretary Jessup; Daniel W. Overocker, Contact Member for the Chapter; and Nord Davis, who at the time was engaged on a plan for zoning the city of Burlington. On several occasions motion pictures were shown—one of them through the courtesy of the A. M. Byers Company.

University of Virginia

Students played an active part in making the 1937–1938 meetings of the University of Virginia Student Chapter a success, having presented eight papers at the seven meetings. Among the outside speakers also heard at these sessions were Lyle F. Bellinger, Vice-President of the Society; Seth Burnley, Contact Member for the Chapter; and Colonel Carruth, district engineer for the U. S. Corps of Engineers at Norfolk. Several inspection trips were enjoyed, and 14 delegates from the Chapter attended the Student Chapter conference at Virginia Military Institute. The Chapter also took charge of arranging civil engineering exhibits for the annual engineers' open house.

University of Washington

The past school year was an outstanding one for the University of Washington Student Chapter. Despite a slight drop in the general civil engineering enrolment, the Chapter had a membership increase of 30. Perhaps the high light of the year was participation in the biennial engineers' open house, in which the Chapter won second place. Among the exhibits entered by the Chapter were working models of a water purification plant and siphon spillway and models of an irrigation project and earth-fill dam under construction. The latter exhibit is shown in the accompanying illustration. Other special activities were a field trip to Seattle's municipal power development on the Skagit River, a picnic, and the annual joint banquet of the Chapter and the Seattle Section of the Society. In all there were 17 meetings, which attracted a total attendance of 722.

Model of Earth-Fill Dam Under Construction Shown at Biennial Engineers' Open House at University of Washington

University of Wisconsin

Members of the faculty played a prominent part in making the 1937–1938 meetings of the University of Wisconsin Student Chapter a success, as they were speakers at five of the eight sessions that were held. The outside speakers were Arthur Kohler, wood technologist at the U. S. Forest Products Laboratory in Madison, and Leon Smith, superintendent of the Madison Water Department. The annual spring picnic, which took place in May, concluded the year's activities.

University of Wyoming

The past year was one of great progress for the University of Wyoming Student Chapter. In addition to ten regular meetings there were many special activities. The biennial inspection trip for juniors and seniors, which took place in the fall, lasted a week and included visits to the Casper Alcova Project and the Seminoe Dam. Later in the year the seniors enjoyed a trip to places of interest in Denver, Colo. Members of the Chapter participated in the regional Student Chapter convention held in Rapid City, S.Dak., and attended the annual convention of the Wyoming Engineering Society at Casper, Wyo. The Chapter also helped sponsor an engineers' ball and prepared numerous exhibits for the annual open house. There was 100 per cent enrolment of those eligible for membership.

Villanova College

An incomplete report from the Villanova College Student Chapter indicates that there were ten meetings during the past year and that entertainment on these occasions was divided between faculty and outside speakers and the showing of the Society's illustrated lectures. The meetings attracted a total attendance of 250.

Vanderbilt University (Robert H. McNeilly)

Several special activities made the past year a memorable one for the Vanderbilt University Student Chapter. At the outset of the year it was decided to utilize the regular monthly meetings for the presentation of student papers, the whole undertaking to be regarded as a contest for prizes donated by the faculty. At the end of the year the first prize went to Paul Clements for his paper on "Engineering and the Engineer," and the second to Alex Kelly for "A Brief History of the Bridge." During the second semester

members of the Chapter lunched together each week and discussed some timely topic previously decided upon. Smokers were enjoyed in December and May, the latter affair being a joint function with other student groups. There was full enrolment of those eligible for membership.

Virginia Polytechnic Institute

Students were instrumental in making the weekly meetings held by the Virginia Polytechnic Institute Student Chapter during the past school year a success. They presented 16 papers at these sessions. On several occasions the Chapter was host to the other student groups on the campus for the showing of motion pictures. Other special events include three smokers and the annual spring picnic. A large delegation from the Chapter went to Lexington, Va., to attend the Student Chapter convention at Virginia Military Institute.

Washington State College

A number of the 13 meetings held by the Washington State College Student Chapter during the past year were devoted to educational lectures given by students and members of the faculty. All the meetings were arranged by the students who displayed a great deal of interest in the programs. Special events consisted of two banquets, held jointly with the University of Idaho Student Chapter, which were greatly enjoyed. On one of these occasions an illustrated talk on "Ten Years in the Tropics," was given by Prof. John K. Pearce, of the University of Washington.

Washington University (Collimation Club)

The Washington University Student Chapter reports 100 per cent enrolment of those eligible for membership. During the 1937–1938 school year there were seven meetings, with a total attendance of 96. The initial activity was a smoker held at the home of Prof. E. O. Sweetser, with Field Secretary Jessup as guest of honor and speaker. Other speakers heard during the year were S. A. Musser, of the A. M. Byers Pipe Company, who discussed the manufacture of wrought-iron pipe; and J. E. Vollmar, vice-president of the Fruin-Colnon Construction Company and newly appointed Contact Member for the Chapter, who discussed matters helpful to the young engineer. In November and February members of the Chapter were guests of the St. Louis Section of the Society, and the Chapter feels that the closer contact with the Section established during the past year augurs well for the future.

Utah State Agricultural College

A twelve-day inspection trip through the Pacific Northwest was the high light of the past school year for the Utah State Agricultural College Student Chapter. Among the projects visited were Grand Coulee Dam, Bonneville Dam, some of the highway and bridge projects in Oregon, and the Golden Gate and San Francisco–Oakland Bay bridges. Twice during the year the Chapter entertained the Utah Section of the Society, and other special events were a dance and the annual engineers' banquet and ball. A number of the Society's illustrated lectures were enjoyed at the 17 meetings, and at other sessions students and outside speakers presented papers.

Members of the Utah State Agricultural College Student Chapter

Virginia Military Institute

Students played an active part in making the 1937–1938 meetings of the Virginia Military Institute Student Chapter a success, having presented 21 papers at the 13 meetings held during the year. Among the outside speakers were E. M. Hastings, Contact Member for the Chapter; H. Weiss, of the American Caribbean Company; Lyle F. Bellinger, Vice-President of the Society; and Wort Faulkner, personnel director of the Blueridge Corporation. In April the Chapter was host to the fourth annual conference of Student Chapters in the state. The regular academic work was supplemented by a number of interesting inspection trips, the places visited including the shops of the Norfolk and Western Railroad and the Virginia Bridge and Iron Works, both in Roanoke. The accompanying photograph was taken on a geology field trip. There was full enrolment of those eligible for membership in the Chapter.

A Few Members of Virginia Military Institute Student Chapter on Geology Field Trip

West Virginia University

Although the West Virginia University Student Chapter is small, the group maintains a high level of activity. One evidence of this is the fact that 76 student papers were presented at the 19 meetings held during the year. At some of the sessions the Society's illustrated lectures were also enjoyed, and there were several outside speakers. Among the latter were L. F. Bellinger, Vice-President of the Society, and H. O. Cole, Contact Member for the Chapter. Members of the Student Chapter took an active part in making the annual engineers' show held at West Virginia University a success, and the exhibits entered by the Chapter were widely commended. There was 100 per cent enrolment of those eligible for membership.

Worcester Polytechnic Institute

Attendance at the Fall Meeting of the Society in Boston initiated the 1937–1938 activities of the Worcester Polytechnic Institute Student Chapter. The seven regular meetings held during the year attracted a total attendance of 220. Among the outside speakers secured at these sessions were Allen P. Richmond, Jr., assistant to the Secretary of the Society; J. H. Brooks, Jr., superintendent of sewers for the city of Worcester; and Leon A. Goodale, of the Worcester Water Department. The annual banquet, which took place in May, concluded the year's activities.

Yale University

There was 100 per cent enrolment of those eligible for membership in the Yale University Student Chapter during the past academic year. Among the speakers who addressed the eight meetings were Charles E. Smith, vice-president of the New York, New Haven and Hartford Railroad and Contact Member for the Chapter; Hardy Cross, chairman of the department of civil engineering at Yale; John C. Tracy, professor emeritus of civil engineering; and Henry W. Buck, consulting engineer of Hartford, Conn. In March the Chapter entered some interesting displays in the third annual engineering exhibition, and in April members of the Chapter were guests of the Connecticut Section at a joint dinner meeting.

ITEMS OF INTEREST

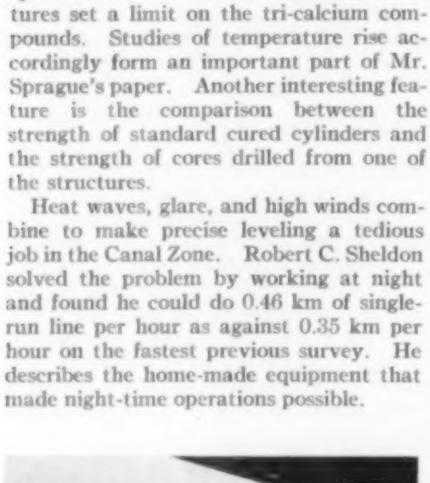
Engineering Events in Brief

Civil Engineering for December

Decline in railway freight revenues has been attributed to unrestrained competition, to the depression, and to a variety of other factors. But in his paper in the December issue of Civil Engineering, Stephen R. Truesdell points to a more fundamental cause which indicates that this loss of traffic may be permanent. If so, the rate structure set up under conditions of constantly increasing traffic will need revision. Coordination and consolidation of transportation facilities, including motor transport, he says, offer a partial solution to the rail problem. On the part of the railroads there must be repeated reorganizations, and gradual abandonment of unproductive lines; and there must be some concessions from labor, and a broader interpretation by the Interstate Commerce Commission of the Motor Carrier Act of 1935.

Of interest to all engineers concerned with the design and control of concrete is the paper by John C. Sprague, also scheduled for December, describing the procedure followed and the results obtained in producing concrete for the locks and dams of the Kanawha River Recanalization Project. With a view to reducing the heat generated in the concrete, the specifications for cement for certain structures set a limit on the tri-calcium compounds. Studies of temperature rise accordingly form an important part of Mr. Sprague's paper. Another interesting feature is the comparison between the strength of standard cured cylinders and the strength of cores drilled from one of the structures.

Heat waves, glare, and high winds combine to make precise leveling a tedious job in the Canal Zone. Robert C. Sheldon solved the problem by working at night and found he could do 0.46 km of single-run line per hour as against 0.35 km per hour on the fastest previous survey. He describes the home-made equipment that made night-time operations possible.



Tests on Concrete Beams with Solid Plate Web Reinforcement Are Described in the December Issue

That concrete beams with web plates of thin steel would be simpler to build than beams with conventional stirrups, and that they may also be superior in structural action, is indicated by tests made at Johns Hopkins University. J. Trueman Thompson, Thomas F. Hubbard, and John N. Fehrer report their research in the hope that others with better facilities may extend it.

Other papers on the December schedule include the second article by General Ferguson on the Mississippi River Cutoffs, and several abridgments of papers from the Fall Meeting program on such varied subjects as flood control, traffic engineering, and sludge treatment.

American Society of Mechanical Engineers Elects Officers

Alexander G. Christie, Professor of Mechanical Engineering at Johns Hopkins University, has been elected president of the American Society of Mechanical Engineers for the year 1939. Other new officers include the following:

Vice-presidents: Henry H. Snelling of Washington, D.C.; William Lyle Dudley of Seattle, Wash.; Alfred Iddles of New York, N.Y.; and James W. Parker of Detroit, Mich. Managers: Clarke Freeman of Providence, R.I.; William H. Winterrowd of Chicago, Ill.; and Willis R. Woolrich of Austin, Tex.

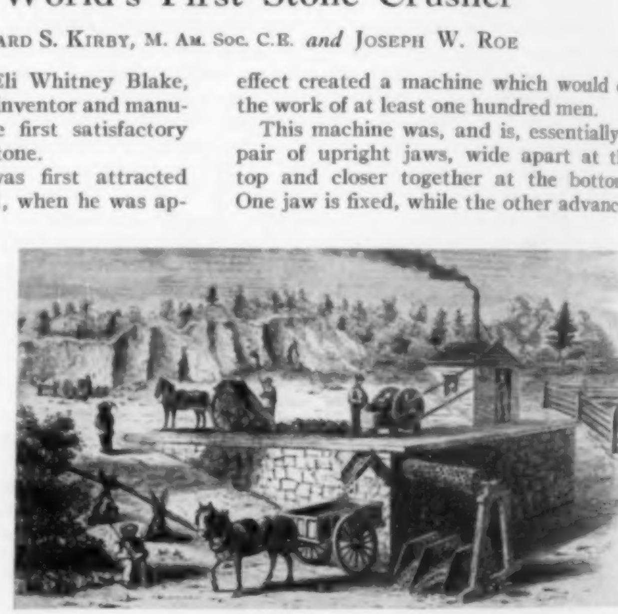
The World's First Stone Crusher

By Richard S. Kirby, M. Am. Soc. C.E. *and* Joseph W. Roe

Eighty years ago Eli Whitney Blake, a New Haven (Conn.) inventor and manufacturer, produced the first satisfactory machine for crushing stone.

Blake's attention was first attracted to the problem in 1851, when he was appointed to a commission to "macadamize" a two-mile stretch of rough cart path that is now Whalley Avenue. There was no one in the city who could tell him how the work should be done, for such a road was still almost a curiosity in America—there were not a dozen miles of it in all New England. Apparently the commission proceeded to surface Whalley Avenue with stone fragments, broken up by sledges and hand-hammers.

But Blake was not satisfied with the result. He puzzled for the next seven years over the problem of how to use steam or water power to break stone like trap rock into small and more or less cubical bits. Finally he hit on the solution—a jaw crusher. The proper proportions and details of each part he worked out on paper before proceeding to build the machine. He found out by experiment just how much pressure it took to break trap rock. So carefully was his "stonebreaker," as he called it, designed, that the first machine served, with only slight modifications, as a pattern for the hundreds of all sizes that followed within the next few years. He secured a patent in 1858. His device has ever since been recognized the world over as the first successful stone crusher. He had in effect created a machine which would do the work of at least one hundred men.



Demonstration of Blake Stone Crusher, About 1875

This machine was, and is, essentially a pair of upright jaws, wide apart at the top and closer together at the bottom. One jaw is fixed, while the other advances toward and recedes from it, with a sort of vibratory motion. Power is applied through a flywheel. The large stones which are fed in at the top are gradually crushed smaller as they descend, and finally drop down into a bin.

Blake's invention deserves a high place because it was not simply an improvement or modification, as many inventions are, of something that already existed; it was a new creation. Within a few years it had entered four major fields—highway construction, railroad track work, concrete foundations, and mining.

The first Blake crusher was set up, it would seem, on a little knoll just to the east of a spur of West Rock, close to what is now Springside Avenue, New Haven. In fact a little crushing plant has been in operation there within this generation. The spot deserves to be marked.

Additional Awards for Papers on Welding

LAST month's account of the James F. Lincoln Arc Welding Foundation's award program did not include the names of any of the "honorable mention" winners. More than twenty of these prizes, amounting to $101.75 each, went to members of the Society or were shared by them with co-authors. The following list, compiled at Society Headquarters, is believed to be complete:

In the watercraft classification: C. Perry Streithof; E. L. Shoemaker.

In the structural classification: Dewey M. McCain; W. S. McFetridge and J. W. Hopkins, jointly; Ned L. Ashton; Richard de Charms; K. B. Wolfskill; Harry H. Hawley (jointly with Kiser E. Dumbauld); Werner Ammann and Meier G. Hilpert, jointly; Glenn L. Enke; C. H. Sandberg; Martin P. Korn; Richard Pfaehler; P. E. Gisiger (jointly with W. M. H. Ballantyne).

In the containers classification: R. E. J. Summers (jointly with J. Borge); Nathaniel J. Kendall; William Landsiedel.

In the functional machinery classification: P. A. Fanner; Kenneth G. Wilkes; Walter D. Myers (jointly with Michael Fourny).

Page of Special Interest

THIS month's frontispiece features a night view of the largest cantilever span in the country—a part of the San Francisco–Oakland Bay Bridge—as seen from Yerba Buena Island. The picture reproduced is one that appears in the Society's expanded lantern lecture on this bridge.

For information regarding this and other lectures available for use by Student Chapters, see page 770 of this issue.

Data Sought on Effects of Shortening the Inch

A COMMITTEE of the Section of Geodesy, American Geophysical Union, is seeking information on the possible effects of the proposed change in the length of the inch on geodetic and geophysical work, scientific investigations, and engineering projects.

The change, proposed in a bill introduced at the last session of Congress, would define the inch as 0.0254 meters, making it shorter by about one part in 500,000 than at present. It is doubtful if the small change in the ratio can directly affect any measurements except those carried out under carefully controlled laboratory conditions, but it will affect, by definition, computed or published data, tables, or formulas which have used the present ratio as a mathematically exact factor.

The investigating committee consists of Dr. L. V. Judson of the National Bureau of Standards, Hugh C. Mitchell of the U. S. Coast and Geodetic Survey, and R. M. Wilson, M. Am. Soc. C.E., of the U. S. Geological Survey. Readers desiring to contribute constructive comments on the matter should write the chairman, Mr. Wilson, in Washington, D.C.

Brief Notes from Here and There

A SYMPOSIUM on three-dimensional photoelasticity will be featured at the eighth semi-annual meeting of the Eastern Photoelasticity Conference, to be held at Columbia University on December 10. Persons who have carried out investigations in this field and who wish to report on the results are invited to send detailed information at once to R. D. Mindlin, Engineering Building, Columbia University, New York, N.Y.

* * * *

THE July, August, and September numbers of CIVIL ENGINEERING carried lists of members who were awarded honorary degrees during the past commencement season. To this list can now be added the names of Arthur W. French and Sir Alexander Gibb, who have been awarded the degrees of doctor of engineering at Worcester Polytechnic Institute and doctor of laws at the University of Edinburgh, respectively.

NEWS OF ENGINEERS

Personal Items About Society Members

JEAN H. KNOX, consulting and construction engineer of Dallas, Tex., has organized the Vacumite Company, Inc., at Dallas. Mr. Knox is president of this new company, which specializes in the rehabilitation of old masonry buildings, dams, and structural steel.

HERMAN G. BAITY, professor of sanitary engineering at the University of North Carolina, has been appointed special engineer for the PWA to represent that organization in the formulation of a program of public works in North Carolina. Professor Baity was state director of PWA from 1933 to 1936.

S. J. CHAPLEAU has retired as superintending engineer of the Department of Public Works of Canada after spending most of his professional career in the service of the Canadian government.

DUDLEY H. JONES, previously maintenance engineer for the Oklahoma State Highway Commission, has been made director of the Oklahoma Highway Planning Survey.

WILLIAM CHESTER MORSE, consulting engineer of Seattle, Wash., has been appointed water superintendent of that city.

JOHN W. DOUGHERTY has been appointed an instructor in the department of mechanics of the college of engineering of the Carnegie Institute of Technology.

ALBERT E. GIVAN, for a number of years chief engineer and general manager of the Sacramento (Calif.) Municipal Utility District has left that position to fill the newly created post of consulting engineer.

WARREN E. WILSON, formerly assistant professor of civil engineering at the South Dakota State School of Mines, has accepted a similar position in the college of engineering at Tulane University.

ROBERT A. THOMPSON was recently appointed the engineering member of the Texas State Board of Health, succeeding the late J. MILTON HOWE.

CHARLES E. DUCKERING is now a surveyor in the U. S. Engineer Office, North Sacramento District, at Marysville, Calif.

LAWRENCE G. PARKER has accepted a position as associate structural engineer in the Procurement Division of the U. S. Treasury Department, with headquarters in Washington, D. C. He was previously structural designer for Graham, Anderson, Probst and White, of Chicago, Ill.

FRANCIS L. CASTLEMAN, JR., formerly assistant professor of civil engineering at Vanderbilt University, has been appointed associate professor of structural engineering in that institution.

ELBERT H. HARVEY has resigned as county road engineer of Mason County, Kentucky, to accept a position as resident engineer in the Kentucky State Highway Department, with headquarters at Owenton, Ky.

EDWARD SOUCEK, until lately instructor and research engineer in the Iowa Institute of Hydraulic Research at the State University of Iowa, is now assistant professor of civil engineering at the University of Toledo.

JEREMIAH TEMPONE has been reappointed engineer special agent, Division of Investigations, Public Works Administration, and assigned for duty to the regional office at Fort Worth, Tex.

LAWRENCE T. WYLY is now assistant professor of civil engineering at Northwestern University. He was formerly connected with the Illinois Division of Highways.

RICHARD L. STEINER has accepted a position as traffic analyst for the State-Wide Highway Planning Survey of the Connecticut State Highway Department, with headquarters at Hartford, Conn.

W. I. GILSON has resigned as manager of the Water Improvement District to become connected with the Valley Clay Products Company, of Mission, Tex.

LAWRENCE B. FEAGIN has been transferred from the U. S. Engineer Office at Nashville, Tenn., where he was principal engineer, to the U. S. Engineer Office at St. Louis, Mo. His title remains the same.

ROBERT W. ABBETT, assistant professor of building construction at Union College, has been granted a leave of absence to become associated with the firm of Parsons, Klapp, Brinckerhoff and Douglas, consulting engineers of New York City.

KENNETH H. TALBOT, until recently concrete engineer on the Parker Dam Project of the U. S. Bureau of Reclamation, now has a similar position with the Harza Engineering Company on the Santee-Cooper Project at Charleston, S.C.

CLEVIS H. HOWELL has resigned as chief engineer of the Los Angeles County Flood Control District to return to the U. S. Bureau of Reclamation, for which he will direct the Colorado–Big Thompson water diversion project.

BRUCE G. JOHNSTON, for the past four years instructor in civil engineering at Columbia University, has been made assistant professor of civil engineering and assistant director of the Fritz Engineering Laboratory at Lehigh University.

CARL AMOS WILSON, formerly assistant county engineer of Wyandotte County, Kansas, has accepted a position as resident engineer for Harrington and Cortelyou, consulting engineers of Kansas City, Mo. Mr. Wilson's headquarters are at Beaumont, Tex.

VIRDEN A. RITTGERS is now associated with the Oklahoma State Department of Public Safety as director of the division of traffic control and regulation. His headquarters are in Oklahoma City, Okla. He was previously city traffic engineer of Oklahoma City.

ARCHIBALD L. PARSONS, rear admiral, CEC, U. S. Navy, retires from active service in the Navy on November 1 and will be associated with Frederic R. Harris, Inc., consulting engineers of New York City, who specialize in the design of waterfront structures.

W. F. SHATTUCK, JR., has severed his connection as construction engineer for the Abbott Laboratories, Chicago, Ill., in order to establish a consulting practice at 221 North La Salle Street, Chicago. He still serves the Abbott Laboratories in a consulting capacity.

E. W. DAVIDSON, formerly assistant structural engineer in the Public Works Department of the U. S. Navy at Bremerton, Wash., is now an associate engineer on the Bonneville Project at Portland, Ore.

RICHARD STEPHENS, JR., has resigned as office engineer for the Metropolitan Water District of Southern California at Banning, Calif., to accept a position as engineer with the International Boundary Commission, with headquarters at El Paso, Tex.

HENRY W. DOUGHERTY is now employed by the Tennessee Valley Authority as an assistant engineering aide on the construction of Gilbertsville Dam, with headquarters at Benton, Ky. Until recently he was in the civil engineering department of the University of Tennessee.

EDMUND L. DALEY, colonel, Corps of Engineers, U. S. Army, has just been promoted to the rank of brigadier general and transferred from New York City, where he was division engineer, to Boston, Mass. He will have command of the First Coast Artillery District.

BLAIR RIPLEY, formerly district engineer for the Canadian Pacific Railway, has been made engineer, maintenance of way, for this railroad. His headquarters are in Toronto, Canada.

MARK G. SANTI has been transferred from the Section of Watershed and Hydrologic Studies of the Soil Conservation Service to the Federal Power Commission, with headquarters in Washington, D.C. He will be in the division of flood control.

JEROME M. RAPHAEL is now employed as an assistant engineer in the U. S. Bureau of Reclamation at Denver, Colo. He was previously a junior engineer in the U. S. Engineer Office at Pittsburgh, Pa.

S. F. YASINES has been promoted from the position of instructor in civil engineering at New York University to that of assistant professor of civil engineering in the same university.

JOSEPH P. MARTIN, previously regional engineer for the U. S. Forest Service at Ogden, Utah, has been transferred to a position with the Federal Power Commission, with headquarters in Washington, D.C.

S. F. CRECELIUS, construction engineer for the U. S. Bureau of Reclamation at Caballo Dam in New Mexico, has been transferred to the Green Mountain Dam of the Colorado–Big Thompson Project.

JAMES C. IRWIN recently retired from the post of valuation engineer of the Boston and Albany Railroad, which he has held since 1914. Last spring Mr. Irwin completed a term as president of the American Railway Engineering Association.

E. B. BAILEY recently resigned as assistant chief draftsman for the Shell Oil Company to accept an appointment as assistant civil engineer with the U. S. Engineer Department, Los Angeles, Calif.

JOHN K. FLYNN, until lately senior engineering aid in the New York State Department of Public Works, is now with the New York City Board of Water Supply at Mt. Kisco, N.Y.

HUGH B. DUNLOP recently resigned as a chainman in the Washington State Department of Highways to accept a position as surveyor with the U. S. Engineer Office at Seattle, Wash.

WALTER J. SOLOMEKIN, formerly inspector of highway construction for the Indiana State Highway Commission, is now employed as a rodman by the Chicago and North Western Railway Company, with headquarters at Norfolk, Nebr.

HORATIO W. FITCH has resigned as assistant professor of civil engineering at North Dakota State College to accept a similar position at the University of Arizona.

DECEASED

CHARLES FRAZINE HAMILTON (M. '14) executive vice-president of the Binkley Coal Company, Chicago, Ill., died in Wilmette, Ill., on September 22, 1938. He was 63. Mr. Hamilton was city engineer of Franklin, Pa., from 1899 to 1904, and vice-president of the Northwestern Construction Company from 1906 to 1916. In the latter year he established and became president of C. F. Hamilton, Inc. Later Mr. Hamilton was vice-president of the Pyramid Coal Corporation, and in 1928 he became vice-president of the Binkley Coal Company.

ALFRED HANSON HARTMAN (M. '12) since 1916 vice-president and general manager of the engineering department of the Consolidated Engineering Company, Inc., of Baltimore, Md., died recently at the age of 59. Mr. Hartman was assistant engineer for the Pennsylvania Railroad Company in 1903; hydraulic engineer for the du Pont Powder Company from 1904 to 1905; and engineer for the Baltimore Sewerage Commission from 1906 to 1916. He was a veteran of the Spanish American War.

The Society welcomes additional biographical material to supplement these brief notes and to be available for use in the official memoirs for "Transactions."

FRANK WASHBURN JENNINGS (M. '18) president of the Jennings-Lawrence Company, of Columbus, Ohio, died at his home in that city on September 28, 1938, at the age of 70. Mr. Jennings began his engineering career in 1885, when he went to work for the Hocking Valley Railroad. Later he was with various railroad companies, and in 1903 he established his private practice in Columbus. During the war Mr. Jennings was chief engineer in charge of Camp Sherman.

RICHARD KHUEN, JR. (M. '98) consulting engineer of Pittsburgh, Pa., died in that city on September 24, 1938, at the age of 73. A brief biography of Mr. Khuen appears in the Society Affairs department of this issue.

WALTER HUNTLEY MANSFIELD (M. '13) until his retirement in 1926 industrial development engineer for the Delaware and Hudson Railroad, died at Colchester, Vt., on September 10, 1938. Mr. Mansfield, who was 75, began his engineering career in 1879 with the Boston and Providence Railroad, and later worked with various engineering firms in Boston. From 1902 to 1912 he was engaged in private practice, and in the latter year he joined the staff of the Delaware and Hudson, with the rank of assistant engineer.

THOMAS HENRY TUTWILER (M. '02) president emeritus and director of the Memphis (Tenn.) Power and Light Company, died in Memphis on September 3, 1938, at the age of 72. Mr. Tutwiler spent his early engineering career in the service of various railroads in the South and Southwest. In 1905 he was elected vice-president and general manager of the Memphis Street Railway Company, and from 1906 to 1923 he was president of that company. In the latter year he became president of the Memphis Power and Light Company, retiring from active duty in 1930.

Changes in Membership Grades

Additions, Transfers, Reinstatements, and Resignations

From September 10 to October 9, 1938, Inclusive

Additions to Membership

Adams, Rob Roy (Assoc. M. '38), Engr., Box 814, Greenville, S.C.

Ashton, George Crapser (Assoc. M. '38), With C.B. & Q.R.R., Chicago (Res., 622 South Monterey, Villa Park), Ill.

Blackburn, Karl Richard (Jun. '38), 954 North West Boulevard, Columbus, Ohio.

Blackwell, Delber Lloyd (Jun. '38), 4545 Main St., Kansas City, Mo.

Blair, Robert Collyer (Assoc. M. '38), Senior Engr., U. S. Engr. Office (Res., 1 Bellvue Heights), Binghamton, N.Y.

Blue, Jack Washburn (Jun. '38), Care, Dept. of Highways, Box 98, Wenatchee, Wash.

Bodine, Robert Yeomans (Jun. '37), 721 Hawthorne Rd., Bethlehem, Pa.

Botsford, John Robert (Assoc. M. '38), Senior Draftsman, Dept. of State (Res., 701 North McCullough St.), San Benito, Tex.

Bourgin, Charles Gillman (Assoc. M. '38), Asst. Supt., Water Supply, Town of Montclair (Res., 10 Jefferson Pl.), Montclair, N.J.

Brothers, LeRoy Arglus (Assoc. M. '38), Asst. Prof., Civ. Eng., Drexel Inst. of Technology, Philadelphia (Res., 5 Marlborough Rd., Upper Darby), Pa.

Brough, Lionel Frederick (Jun. '37), Insp., U. S. Engrs., War Dept., Binghamton Dist., Security Mutual Bldg., Binghamton, N.Y.

Brown, Linas Hutchins (Jun. '38), 1430 East Marquette Rd., Chicago, Ill.

Buff, Louis Frederic (Affiliate '38), Pres. and Gen. Mgr., Buff & Buff Mfg. Co., Jamaica Plain, Mass.

Cabaniss, Jack Knisley (Jun. '38), Box 114, Mineral Wells, Tex.

Costello, Edward Charles (Assoc. M. '37), Asst. Engr., Dept. of Works and Local Govt. (Res., 14a Clanwilliam St., Willoughby), Sydney, N.S.W., Australia.

Cummins, Thomas Vincent (Jun. '38), Asst. Topographic Engr., U. S. Geological Survey, 1108 Rolla St., Rolla, Mo.

Dawson, Miles Merrill (Assoc. M. '38), Capt., Corps of Engrs., U.S.A.; Asst. Prof., Military Science and Tactics, State Univ. of Iowa (Res., 305 Grand Ave.), Iowa City, Iowa.

Drescher, Francis Andrew (Jun. '38), Asst. Engr., Ohio Highway Board of Inquiry (Res., 3962 West 158th St.), Cleveland, Ohio.

Edson, John Rushell, Jr. (Jun. '38), Del Rio, Tex.

Ely, Verne Jennings (Assoc. M. '38), Associate Bridge Engr., Bridge Dept., State Div. of Highways (Res., 584 Thirty-Fourth St.), Sacramento, Calif.

Epp, Donald Oscar (Jun. '38), 717 Cherry St., Toledo, Ohio.

Eustance, Harry Winfield (M. '38), Civ. Engr., Eng. and Maintenance Dept., Eastman Kodak Co. (Res., 159 Rock Beach Rd.), Rochester, N.Y.

Evans, Joseph Shelton, Jr. (Jun. '38), 1338 Cryer Ave., Cincinnati, Ohio.

Grasso, Warren Alwin (Jun. '38), Special Research Graduate Asst., Univ. of Illinois (Res., 709 West California St.), Urbana, Ill.

Guiney, Fred Melville (Assoc. M. '38), Landscape Engr., State Highway Dept., Phoenix, Ariz.

Hall, Richard Endicott (Jun. '38), 2711 Regent St., Berkeley, Calif.

Hayes, Francis Vincent (Assoc. M. '38), Asst. Section Engr., Board of Transportation, 67 West 44th St. (Res., 651 West 1?8th St.), New York, N.Y.

Hendrick, Wyatt Burl (Jun. '38), County Engr., Comanche County; City Engr., City Hall, Lawton, Okla.

Holt, Joseph Francis (Jun. '38), Engr. Insp., Grade 4, Board of Water Supply, New York City (Res., 505 West 143d St.), New York, N.Y.

Hughes, Joseph Francis (Assoc. M. '38), Gen. Supt., Phoenix Eng. Corporation, New York, N.Y. (Res., 202 Morris Apartments, Omaha, Nebr.)

Hutchinson, Richard Bell (Jun. '38), Research Engr., U. S. Pipe & Foundry Co., Burlington (Res., Jobstown), N.J.

King, Carroll Austin, Jr. (Jun. '38), Box 232, Newton, Tex.

Kuhns, Laurence Bertels (Assoc. M. '38), With Aluminum Co. of America, 801 Gulf Bldg., Pittsburgh (Res., 524 Keystone Drive, New Kensington), Pa.

Lane, Lawrence Alva (Jun. '38), 1821 Hearst Ave., Berkeley, Calif.

Leaver, Robert Edmund (Jun. '38), 801 Lake St., Reno, Nev.

Lipson, Samuel Lloyd (Jun. '37), 703 South Bronson, Los Angeles, Calif.

Lowrance, Frank Emanuel (Jun. '38), Lincoln St., Oxford, Miss.

Lyell, Herbert Leslie (Jun. '38), 788 Palo Alto Ave., Palo Alto, Calif.

McCallum, Gordon Evans (Assoc. M. '38), San. Engr., Kent County (Res., 141 Rose St., S.W.), Grand Rapids, Mich.

McCormick, Charles Washburn Brereton (Jun. '38), 953 South Westmoreland, Los Angeles, Calif.

McLaurin, Banks (Assoc. M. '38), 206 West 32d, Austin, Tex.

Madden, William Francis (Assoc. M. '38), Engr., Carl W. Clark (Res., 37 East Court St.), Cortland, N.Y.

Mitchell, Stewart (Assoc. M. '38), Res. Engr., Bridge Dept., State Div. of Highways (Res., 2625 Rochon Way), Sacramento, Calif.

Moore, Gerald Dixon (Jun. '38), Insp. of Real Estate, Emigrant Industrial Savings Bank, 51 Chambers St. (Res., 1100 Hoe Ave.), New York, N.Y.

Moore, Henry Sperry (Jun. '38), Res. Engr., Frederic R. Harris, Inc., Todd Galveston Dry Docks, Galveston, Tex.

Murphy, Francis Cecil (Jun. '38), U. S. Army Engrs. Office, 751 South Figueroa St., Los Angeles, Calif.

Newton, Carroll Thompson (Jun. '38), 2d Lieut., Corps of Engrs., U.S.A., U. S. Engr. Office, Fort Peck, Mont.

Nold, George Jacob (M. '38), Dist. Engr., U. S. Engr. Office, Security Mutual Bldg., Binghamton, N.Y.

O'Brien, William Edward (M. '38), Vice-Chairman, State Highway Comm., State Office Bldg., Madison, Wis.

Okkerse, John Bertram (Jun. '38), Asst. to Contr. Mgr. and Purchasing Agt., Vermilya-Brown Co., Inc., 100 East 42d St., New York (Res., 33-38 Parsons Boulevard, Flushing), N.Y.

TOTAL MEMBERSHIP AS OF OCTOBER 9, 1938	
Members	5,682
Associate Members	6,213
Corporate Members	11,895
Honorary Members	24
Juniors	3,581
Affiliates	76
Fellows	1
Total	15,577

Olmstead, Carlos Boyes (Jun. '38), Computer, R. of W. Dept., Central Nebraska Public Power and Irrig. Dist., Hastings, Nebr.

Osborn, John Richard (Jun. '38), Instr. and Testing Engr., Dept. of Civ. Eng., Colorado State Coll., Fort Collins, Colo.

Osgood, Seth Phillips (Jun. '38), 2111 Abington Rd., Cleveland, Ohio.

Porak, Henry George (M. '38), Engr., Plans and Surveys, State Highway Dept. (Res., 2508 Washington St.), Olympia, Wash.

Pride, Roland Wynns (Jun. '38), 544 Federal Bldg., Louisville, Ky.

Ramey, John Kimbrough (Jun. '38), City Engr., Oxford, Miss.

Rutledge, Philip Casteen (Assoc. M. '38), Associate Prof., Civ. Eng., School of Civ. Eng., Purdue Univ. (Res., 807 Shawnee Ave.), LaFayette, Ind.

Searcy, James Kincheon (Jun. '38), Res. Engr., Hydr., U. S. Geological Survey, Box 2052, Jackson, Miss.

Simon, Bernard Daniel, Jr. (Jun. '38), 203 South Glenwood Ave., Columbia, Mo.

Slichter, Francis Benjamin (Assoc. M. '38), Civ. Engr., U. S. Engr. Dept., Missouri River Div. (Res., 2030 East 48th Terrace), Kansas City, Mo.

Smith, George Wallace (M. '38), Prof. and Head of Dept. of Eng. Mechanics, North Carolina State Coll. of Agriculture and Eng. of the Univ. of North Carolina (Res., 222 Hawthorne Rd.), Raleigh, N.C.

Smith, Harlen (Jun. '38), 531 East 59th St., Seattle, Wash.

Spalding, Prescott Oulton (Jun. '38), 12 Irving St., Portland, Me.

Spicklemire, Nelson Edwin (Assoc. M. '38), Res. Engr., Bridge Dept., State Div. of Highways, 2087 Evans Ave., Ventura, Calif.

Staley, Howard Raymond (Assoc. M. '38), Room 5-008, Mass. Inst. Tech., Cambridge, Mass.

Stevens, James Winlock (Jun. '38), Asst. Res. Engr., State Highway Dept., 410 West 34th St., Austin, Tex.

Stoner, Harry Leroy (Assoc. M. '37), 1950 Rimpau Boulevard, Los Angeles, Calif.

Strumer, Samuel (Assoc. M. '38), Engr., Dept. of Buildings, Borough of Manhattan, New York (Res., 10 Overlook Rd., White Plains), N.Y.

Symns, Clarence, Jr. (Jun. '38), Peterstown, W. Va.

Tanner, Burford Maurice (Jun. '38), Care, U. S. Forest Service, Glendora, Calif.

Thigpen, Hugh McGhee (Assoc. M. '38), Care, U. S. Engr. Office, Survey Section, 400 Broadway, Little Rock, Ark.

Thomas, Albert Lane (Jun. '38), Surveyman and Junior Engr., U. S. Engrs., War Dept., Pittsburgh Dist., U. S. Engr. Office, Chamber of Commerce Bldg., Pittsburgh, Pa.

Velzy, Charles R. (M. '38), Designing and Constr. Engr., Greeley & Hansen, 6 North Michigan Ave., Chicago, Ill. (Res., 240 Wallace Ave., Buffalo, N.Y.).

Villanueva U, Eduardo Antonio (Assoc. M. '38), Aide-de-Camp to the Pres. of Venezuela, Miraflores a Santa Barbara 57, Caracas, Venezuela.

Walsh, Everett Lincoln (Assoc. M. '38), Associate Bridge Engr., State of California (Res., 1617 Thirty-Ninth St.), Sacramento, Calif.

Werner, Gustave George, Jr. (Assoc. M. '38), Res. Engr., Malcolm Pirnie, 25 West 43d St., New York, N.Y.

White, Julian Herbert (Assoc. M. '38), Asst. Engr., Bangor Hydro-Elec. Co., Bangor (Res., 84½ Washington St., Brewer), Me.

Whitley, Fenner Harvey (Jun. '38), Instr., San. Eng., Coll. of Eng., New York Univ., University Heights, New York, N.Y.

WHITTINGTON, RUSSELL ROWE (Assoc. M. '38), Constr. Engr., Am. Smelting & Refining Co., Gen. Eng. Dept. (Res., 2607 Grant Ave.), El Paso, Tex.

WILSON, THOMAS EVANS, JR. (Jun. '38), Asst., Res. Engr., State Highway Dept., Box 325, Bamberg, S.C.

ZABOROWSKI, ROBERT (Jun. '38), 1210 West Green St., Urbana, Ill.

MEMBERSHIP TRANSFERS

BAILY, WILLIAM EDINGTON (Jun. '34; Assoc. M. '38), Stress Engr., Boeing Aircraft Co., Georgetown Station (Res., 907 Summit Ave.), Seattle, Wash.

BERGMAN, VICTOR ROBINSON (Jun. '37; Assoc. M. '38), Estimator and Engr., Godwin Constr. Co., 370 Lexington Ave. (Res., 265 Riverside Drive), New York, N.Y.

CLARKE, JOHN WHITE (Jun. '27; Assoc. M. '38), Field Engr., TVA, Box 602, Guntersville Dam, Ala.

DAVIS, HARMER ELMER (Jun. '28; Assoc. M. '38), Asst. Prof., Civ. Eng., Univ. of California, 301 Eng. Materials Laboratory, Univ. of California, Berkeley, Calif.

DEMING, STEPHEN ARTHUR (Jun. '34, Assoc. M. '38), Associate Engr., State Highway Comm., Maintenance Dept., 5117 East 31st St. (Res., 4744 Belleview Ave.), Kansas City, Mo.

GARRETT, ROY STUART (Assoc. M. '24; M. '38), Asst. City Engr. (Res., 120 Catoma St.), Montgomery, Ala.

GOSSETT, FRANKLIN RICE (Jun. '27; Assoc. M. '38), Lieut. (j.g.), U. S. Coast and Geodetic Survey, Junior Hydr. and Geodetic Engr., Ship Hydrographer, Box 452, Palatka, Fla.

JOHNSTON, CLAIR CRAWFORD (Assoc. M. '35; M. '38), Prof., Civ. Eng., Univ. of Detroit, Livernois Ave. and McNichols Rd., Detroit, Mich.

LEE, DONOVAN HENRY (Jun. '25; Assoc. M. '31; M. '38), Chf. Engr., Christiani & Nielsen, Ltd., Romney House, Marsham St., London, S.W. 1, England.

LEWIN, JOSEPH DAVID (Jun. '35; Assoc. M. '38), Hydr. Designer, Phoenix Eng. Corporation, 2 Rector St. (Res., 834 Riverside Drive), New York, N.Y.

LUND, GEORGE ALFRED (Assoc. M. '94; M. '38), (Retired) 21 East 52d St., New York, N. Y.

MCGAW, ALEX JAMES (Jun. '35; Assoc. M. '38), Asst. Prof., Civ. Eng., Univ. of Wyoming, Laramie, Wyo.

MEYER, ADOLF ARNOLD (Assoc. M. '24; M. '38), Senior Civ. Engr., TVA (Res., Whittle Springs Hotel), Knoxville, Tenn.

WARD, RICHARD B. (Assoc. M. '33; M. '38), Care, U. S. Bureau of Reclamation, Denver, Colo.

WEIRICH, ALFRED FRANKLIN (Jun. '31; Assoc. M. '38), Care, WPA Constr. Office, U. S. Naval Academy, Annapolis, Md.

REINSTATEMENTS

ADAMS, JAMES WENDELL, Assoc. M., reinstated Sept. 23, 1938.

BEECHLEY, EDGAR HOMER, M., reinstated Sept. 23, 1938.

BROWNE, FLOYD GILMORE, Assoc. M., reinstated Oct. 3, 1938.

FOSTER, ALEXANDER, JR., M., reinstated Sept. 23, 1938.

GLEDHILL, WILLIAM LAWRENCE, Assoc. M., reinstated Sept. 22, 1938.

HEINS, HENRY, M., reinstated Sept. 23, 1938.

KAREKIN, YAZUJIAN MARDIG, M., reinstated Sept. 23, 1938.

LINDSAY, JOHN, Assoc. M., reinstated Oct. 3, 1938.

MCIVER, ANGUS VAUGHN, Assoc. M., reinstated Sept. 23, 1938.

MANN, CLAIR VICTOR, M., reinstated Oct. 5, 1938.

SPURNEY, FELIX EMANUEL, Assoc. M., reinstated Sept. 23, 1938.

SULLIVAN, CLARENCE THIEL, Assoc. M., reinstated Oct. 3, 1938.

SWENDSEN, MYRON M., reinstated Sept. 23, 1938.

RESIGNATIONS

DAVIS, EDWARD RUSSELL, Assoc. M., resigned Oct. 5, 1938.

FISHER, FREDERICK WILLIAM, M., resigned Sept. 14, 1938.

ROLLER, JOHN EDWIN, Assoc. M., resigned Sept. 14, 1938.

VANCE, JAMES DAVIS, Jun., resigned Oct. 5, 1938.

WEINER, RUDOLPH SIGMUND, Assoc. M., resigned Sept. 23, 1938.

Applications for Admission or Transfer

Condensed Records to Facilitate Comment of Members to Board of Direction

November 1, 1938 NUMBER 11

The Constitution provides that the Board of Direction shall elect or reject all applicants for admission or for transfer. In order to determine justly the eligibility of each candidate, the Board must depend largely upon the membership for information.

Every member is urged, therefore, to scan carefully the list of candidates published each month in CIVIL ENGINEERING *and to furnish the Board with data which may aid in determining the eligibility of any applicant.*

It is especially urged that a definite recommendation as to the proper grading be given in each case, inasmuch as the grading must be based upon the opinions of those who know the applicant personally as well as upon the nature and extent of his professional experience. Any facts derogatory to the personal character or professional reputation of an applicant should be promptly communicated to the Board.

Communications relating to applicants are considered strictly confidential.

The Board of Direction will not consider the applications herein contained from residents of North America until the expiration of 30 days, and from non-residents of North America until the expiration of 90 days from the date of this list.

MINIMUM REQUIREMENTS FOR ADMISSION

GRADE	GENERAL REQUIREMENT	AGE	LENGTH OF ACTIVE PRACTICE	RESPONSIBLE CHARGE OF WORK
Member	Qualified to design as well as to direct important work	35 years	12 years*	5 years of important work
Associate Member	Qualified to direct work	27 years	8 years*	1 year
Junior	Qualified for sub-professional work	20 years †	4 years*	
Affiliate	Qualified by scientific acquirements or practical experience to cooperate with engineers	35 years	12 years*	5 years of important work
Fellow	Contributor to the permanent funds of the Society			

* Graduation from an engineering school of recognized reputation is equivalent to 4 years of active practice.
† Membership ceases at age of 33 unless transferred to higher grade.

The fact that applicants refer to certain members does not necessarily mean that such members endorse.

ADMISSIONS

MEMBER

CLAY, LUCIUS DUBIGNON, Denison, Tex. (Age 41.) Capt., Corps of Engrs., War Dept., U. S. Army; in charge of Denison Dam Area Office. Refers to G. E. Edgerton, W. Gerig, H. Kramer, T. B. Larkin, W. H. McAlpine, E. M. Markham, B. B. Somervell, M. C. Tyler.

COOK, CHARLES EDWARD, Arlington, Va. (Age 36.) Asst. Prof. of Civ. Eng., George Washington Univ. Refers to R. W. Crum, B. H. Frasch, E. F. Gillen, C. A. Hogentogler, J. R. Lapham.

DERR, ORVILLE VOSBURY, Mt. Vernon, N.Y. (Age 53.) Valuation Engr., Valuation Dept., on staff of Asst. Vice-Pres., Erie R.R. Refers to H. F. King, C. A. Mead, C. H. Moore, E. P. Palmer, J. W. Smith, C. H. Splitstone.

DUNBAR, CRAWFORD KYLE, Atlanta, Ga. (Age 43.) Asst. Constr. Engr., RA, LU Div., Regional Office. Refers to W. Finnell, J. M. Garrett, R. S. Garrett, J. W. Hawkins, H. H. Houk, B. W. Pegues, I. E. Root.

GORMAN, WILLIAM CAMPBELL, Cairo, Ill. (Age 37.) Res. Engr. on Ohio River Bridge, Cairo, Ill., with Modjeski & Masters, Harrisburg, Pa. Refers to M. B. Case, C. G. Conley, E. H. Connor, F. M. Masters, C. G. Melville, R. Modjeski.

HILTABIDLE, WILLIAM ORME, JR., San Diego, Calif. (Age 42.) Lt. Commander, Corps of Civ. Engrs., U. S. Navy, being Public Works Officer, Naval Air Station. Refers to R. E. Bakenhus, G. S. Burrell, C. A. Carlson, B. Moreell, A. L. Parsons, R. M. Warfield, R. Whitman.

HOUSTON, ALBERT JR., Chicago, Ill. (Age 38.) Pres. and Treas., Midland Constrs. Inc.; on leave from Harza Engineering Co. Refers to A. J. Ackerman, W. J. Barney, H. K. Barrows, E. F. Haas, L. F. Harza, J. C. Hays, C. H. James, J. Nicolet, H. G. Roby, J. L. Schnitz.

JONES, HOWELL CARLISLE, Barnwell, S.C. (Age 39.) Gen. Mgr. for C. G. Fuller, Contr. Refers to R. B. Cureton, D. T. Duncan, A. Epstein, A. E. Johnson, T. K. Legare, L. S. Le Tellier, L. W. Pollard, W. W. Wannamaker, Jr., J. G. Wardlaw, Jr.

LAUER, WILLARD WOOD, Painesville, Ohio. (Age 44.) Gen. Supt., H. K. Ferguson Co., Cleveland, Ohio. Refers to F. W. Daniels, W. R. Eberhardt, G. G. Kelcey, C. B. Stanton, A. N. Talbot.

RAVER, PAUL JEROME, Chicago, Ill. (Age 44.) Associate Prof., Public Utilities, Northwestern Univ., also Executive Officer, Illinois Commerce Comm. Refers to C. E. DeLeuw, H. B. Fleming, E. Jony, F. R. McMillan, J. F. Still.

Seifried, Charles Frank, Cheyenne, Wyo. (Age 53.) Supt., Wyoming State Highway Comm. Refers to E. W. Burritt, J. B. Cleary, J. A. Elliott, R. D. Goodrich, R. A. Klein, H. T. Person, Z. E. Sevison.

ASSOCIATE MEMBER

Biggs, Edwin Forrest, Norris, Tenn. (Age 34.) Production Engr. and Engr. in charge of drafting Service Div. of Design Dept., TVA. Refers to A. L. Alin, W. B. Allen, H. A. Hageman, R. M. Riegel, L. G. Warren.

Burleigh, Harry Paul, Amarillo, Tex. (Age 30.) Associate Hydr. Engr., Div. of Land Economics, Bureau of Agricultural Economics. Refers to H. B. Elmendorf, A. G. Fiedler, E. C. Gwillim, J. E. Hayes, G. L. Seligmann, R. S. Watts.

Carrier, Ronald Henry, District Manbhum, India. (Age 30.) Refers to N. J. Durant, G. Wilson. (Applies in accordance with Sec. 1, Art. I of the By-Laws.)

Cowin, Alden Lloyd, Redwood City, Calif. (Age 46.) Office Engr., Hetch Hetchy Water Supply of City & County of San Francisco. Refers to R. L. Allin, R. S. Anderson, J. H. Hampson, L. T. McAfee, C. R. Rankin, L. W. Stocker, J. H. Turner.

Crawshaw, Arthur Clyde, Mason City, Wash. (Age 40.) Quantity Engr., Consolidated Bldrs., Inc., responsible for gathering, computing, compiling, and recording materials for Grand Coulee Dam, etc. Refers to C. M. Berry, A. V. Bowhay, J. H. Diehl, A. Donaldson, C. R. Goodrich, J. R. Jahn, F. A. Kittredge, A. R. Nieman.

Davis, Philip, Tuscaloosa, Ala. (Age 29.) With U. S. Engrs., loaned to Rome Flood Control Project as Concrete Technologist on lock and dam. Refers to G. J. Davis, Jr., D. C. A. duPlantier, H. H. Houk, S. C. Houser, S. T. Jones, Jr., D. W. Mead, T. A. Smith, J. K. Woolf.

Deewall, Lorin William, San Diego, Calif. (Age 41.) County Planning Engr., San Diego County Planning Comm. Refers to T. J. Allen, M. C. Blanchard, H. A. Noble, F. D. Pyle, R. R. Rowe, P. R. Watson.

Doolittle, Frederick Joseph, Maywood, Calif. (Age 32.) Inspector, Officeman and Chf. of Party at Consolidated Steel Corporation, Metropolitan Water Dist. of Southern California. Refers to G. E. Baker, J. B. Bond, R. B. Diemer, H. G. Matthews, D. C. May, R. Stephens, Jr., K. Q. Volk.

Ernst, George Campbell, College Park, Md. (Age 33.) Asst. Prof. of Civ. Eng., Univ. of Maryland, in responsible charge of courses, also of Projects 1 and 5, Eng. Experiment Station. Refers to R. A. Caughey, J. H. Cissel, A. H. Fuller, H. J. Gilkey, L. M. Gram, R. H. Sherlock, S. S. Steinberg.

Fowler, Randall Boone, New Orleans, La. (Age 48.) State Director of Operations, U. S. Relief Organizations. Refers to J. T. Bullen, J. M. Fourmy, L. G. Frost, H. M. Gallagher, F. G. Jonah, A. J. Negrotto, G. P. Rice, J. L. White.

Kuss, Theodore Martin, San Francisco, Calif. (Age 35.) Chf. Engr., Pacific Bridge Co. Refers to J. R. Blondin, C. Derleth, Jr., P. Hart, J. Jones, L. L. Martin, M. P. O'Brien, G. B. Woodruff.

Ludasy, Marcell, Trenton, N.J. (Age 41.) Bridge Designer, Bridge Div., New Jersey State Highway Dept. Refers to C. S. Bissell, M. Goodkind, E. H. Harder, H. F. Harris, L. C. Petersen, L. R. Schureman.

Maca, Leon Francis, Denver, Colo. (Age 33.) Asst. Civ. Engr., Water Resources Sec., U. S. Bureau of Reclamation. Refers to E. B. Debler, H. H. Hodgeson, A. Johnson, A. F. Johnson, R. L. Lowry, Jr., J. P. Martin, R. G. Stevenson, R. R. Zack.

McMordie, Robert Campbell, Niagara Falls, Ont., Canada. (Age 30.) Structural Engr., H. G. Acres & Co. Ltd. Refers to H. G. Acres, L. H. Burpee, A. H. Harkness, T. H. Hogg, J. H. Ings, I. T. C. Larnder, C. H. Mitchell, C. R. Young.

Miller, Lloyd Martin, Dayton, Tenn. (Age 33.) Res. Engr., Highway & R. R. Div., TVA. Refers to R. P. Holley, J. F. Partridge, T. P. Pendleton, L. F. Pratt, J. A. Riviere.

Mire, Ernest Lewis, New Orleans, La. (Age 30.) With Public Belt R.R. Comm. of New Orleans, being Asst. Engr. in charge of maintenance of way and structures, including Mississippi River Bridge at New Orleans. Refers to V. J. Bedell, D. W. Godat, A. H. Guillot, W. T. Hogg, H. G. Lytle, J. A. McNiven, F. M. Masters, C. G. Melville.

Nelson, Ernest Benjamin, Seattle, Wash. (Age 53.) Refers to R. P. Carr, G. Mattis, H. C. Rapp, T. D. Sawyer, C. E. Seage, A. L. Wilcox.

Orsini, Felice Marino, Spartanburg, S.C. (Age 31.). Regional Chf. Draftsman, Soil Conservation Service, U. S. Dept. of Agriculture. Refers to G. M. Bowers, F. B. Campbell, B. Clement, R. D. Gladding, C. M. Strahan.

Ridley, Elgan McNeile, Brownsville, Tex. (Age 35.) Civ. Engr. and Surveyor, also County Surveyor of Cameron County. Refers to A. E. Anderson, W. I. Gilson, E. B. Gore, A. Tamm, W. O. Washington, B. F. Williams.

Stanley, Wyatt Richard, Amarillo, Tex. (Age 29.) Jun. Engr., Bureau of Agricultural Economics. Refers to H. B. Elmendorf, J. F. W. Gebhardt, J. E. Hayes, J. W. Pritchett, G. L. Seligmann, W. A. von Schoeler.

Stribling, William John, High Point, N.C. (Age 37.) Res. Engr. with Frank T. Miller, Cons. Engr., Greensboro, N.C.; also Lieut., C.E.C., U. S. Naval Reserve. Refers to F. J. Blythe, E. L. Clarke, F. T. Miller, L. M Ross, G. T. Rude, J. N. Stribling, G. W. Ward, N. Williams.

Summers, Glenn Lewis, Kanona, N.Y. (Age 33.) First Lieut., U. S. Army on CCC activities at Leicester, Castile, and Kanona. Refers to C. E. Beam, R. P. Black, J. H. Granbery, G. S. Murphy, F. C. Snow.

JUNIOR

Branick, Wayne D., Girard, Kans. (Age 26.) With 2d Dist., Kansas, WPA, on civ. eng. work. Refers to W. E. Baldry, F. F. Frazier, M. W. Furr.

Coates, John James, New York City. (Age 23.) Research Fellow for the Freeport Sulphur Co.; Research Fellow in San. Eng., New York Univ. Refers to L. V. Carpenter, H. E. Wessman.

Cravens, James Wade, Paris, Tex. (Age 28.) Jun. Res. Engr., Texas State Highway Dept. Refers to L. D. Cabaniss, C. C. Cagle, F. M. Davis, A. D. Hutchison, J. E. Pirie.

Dennis, Ora Avis, Seattle, Wash. (Age 29.) Refers to G. E. Hawthorn, A. L. Miller, C. C. More, F. H. Rhodes, Jr., R. G. Tyler, R. B. Van Horn.

Hall, John Fenwick, Junction City, Kans. (Age 28.) Asst. City Engr., drafting plans for WPA projects. Refers to F. F. Frazier, M. W. Furr.

Harrison, Evelyn (Miss), Washington, D.C. (Age 28.) Cartographic Draftsman, Cartographic Sec., U. S. Geological Survey, Dept. of Interior. Refers to A. F. Hassan, J. G. Staack.

Hastilovich, John, Washington, D.C. (Age 21.) Asst. Eng. Aide, Bureau of Constr. & Repair, Navy Dept. Refers to W. Allan, T. H. Prentice.

Johnson, Carl Burdett, Hollywood, Calif. (Age 23.) Asst. Eng. Aid, U. S. Engr. Dept., Los Angeles, Calif. Refers to R. R. Martel, W. W. Michael, G. F. Whittemore.

Larsen, Herluf Thomsen, Chicago, Ill. (Age 27.) Draftsman and Designer, Charles E. DeLeuw & Co. Refers to H. B. Blodgett, C. E. DeLeuw, C. C. Oleson.

MacLeod, James Henry, Marlboro, Mass. (Age 25.) Refers to G. J. Davis, Jr., D.C.A. duPlantier.

St. Malo, Alberto De, Panama, Panama. (Age 27.) Structural Designer with Grebien & Martinez, Inc. Refers to H. G. Arango, J. B. Babcock, 3d, H. K. Barrows, W. M. Fife, E. Lyons, Jr.

Shea, Nicholas Howard, Washington, D.C. (Age 23.) Refers to C. A. Ellis, R. B. Wiley.

Stuart, Wilbur Tennant, Grand Canyon, Ariz. (Age 29.) Hydr. Engr. and Res. Engr., U. S. Geological Survey, at Grand Canyon gaging station. Refers to P. S. Bailey, J. A. Baumgartner, R. L. Downing, C. L. Eckel, J. S. Gatewood.

Sushka, Peter, Washington, D.C. (Age 27.) Eng. Draftsman, Bureau of Soil Conservation, Dept. of Agriculture. Refers to R. E. Goodwin, J. S. Peck.

Vrachos, Christopher, Gloucester, Mass. (Age 24.) Refers to L. F. Bellinger, A. E. Winslow.

Weisshaupt, William Jonathan, Hood River, Ore. (Age 24.) Jun. Engr., Morrison-Knudsen Co., Inc. Refers to J. E. Buchanan, I. N. Carter, I. C. Crawford, J. W. Howard, W. P. Hughes.

Weston, Roy Francis, New York City. (Age 27.) Research Fellow and Part-Time Instructor, New York Univ., research in sewage and industrial-waste treatment; also graduate student, School of San. Eng. Refers to L. V. Carpenter, H. E. Wessman.

Wilson, Tillman Claude, Poteau, Okla. (Age 22.) Refers to C. A. Ellis, R. B. Wiley.

Woodrich, Warren Brown, Minneapolis, Minn. (Age 23.) Refers to C. D. Jensen, H. G. Payrow, H. Sutherland, C. C. Williams.

FOR TRANSFER

FROM THE GRADE OF ASSOCIATE MEMBER

Hayden, Robert, Assoc. M., New York City. (Elected June 15, 1936.) (Age 51.) Asst. to Chf., Contr. Sec., New York World's Fair 1939. Refers to E. K. Abberley, H. W. Durham, H. A. Foster, J. P. Hogan, A. C. Tozzer.

Rugg, Warren Fuller, Assoc. M., New York City. (Elected Nov. 6, 1907.) (Age 60.) Asst. Engr., New York City Planning Comm. Refers to F. E. Cudworth, R. E. Dougherty, L. G. Holleran, F. B. Marsh, R. Ridgway, J. C. Riedel, A. W. Tidd, A. S. Tuttle.

Woodburn, James Gelston, Assoc. M., Madison, Wis. (Elected April 15, 1929.) (Age 43.) Prof. of Hydr. Eng., Chairman, Dept. of Hydr. & San. Eng., Univ. of Wisconsin. Refers to M. Chase, H. W. King, D. W. Mead, G. L. Parker, H. E. Phelps, M. K. Snyder.

Wright, Frederick John, Assoc. M., Ridgewood, N.J. (Elected Junior Jan. 7, 1913; Assoc. M. April 19, 1920.) (Age 50.) Pres. and Treas., Frederick J. Wright Co., Civ. Engrs. and Constructors, also Land Surveyors. Refers to A. T. Cook, C. D. Geiger, G. E. F. Lund, F. W. Schwiers, Jr., J. F. Sanborn.

FROM THE GRADE OF JUNIOR

Anderson, John Gordon, Jun., Denver, Colo. (Elected Oct. 14, 1929.) (Age 32.) Asst. Engr., U. S. Bureau of Reclamation. Refers to H. H. Bennet, F. B. Cook, Jr., L. M. Culver, D. J. Hunt, M. A. Seiler.

Camp, Cecil Sidney, Jun., Syracuse, N.Y. (Elected March 30, 1931.) (Age 31.) Asst. Prof. of Civ. Eng., Syracuse Univ. Refers to C. S. Jones, J. H. Kimball, E. W. Lane, D. M. McCain, F. T. Mavis, L. Mitchell, H. S. Rogers, G. Slover, W. R. Spencer, H. M. Wright, W. W. Zass.

Close, Ross Arthur, Jun., Binghamton, N.Y. (Elected Oct. 26, 1931.) (Age 30.) With U. S. Engr. Office on hydraulic design of flood-control structures. Refers to W. B. E. Anthony, P. C. Gillette, E. M. Graf, N. J. Hainovsky, C. L. Harris, H. Larson, H. Miller.

Finlay, Sam, Jun., Glen Ferris, W. Va. (Elected Dec. 3, 1928.) (Age 32.) Hydr. Engr., Michigan Northern Power Co. Refers to L. H. Davis, O. M. Jones, W. J. Krefeld, J. E. Settle, W. S. Winn.

Hanson, Thomas Cooper, Jun., Detroit, Mich. (Elected Jan. 13, 1936.) (Age 32.) Asst. Prof., Dept. of Civ. Eng., Univ. of Detroit. Refers to P. G. Brown, W. I. Freel, W. J. Henderson, C. C. Johnston, G. P. Springer, L. C. Wilcoxen, R. B. Wiley.

Holt, Marshall, Jun., Arnold, Pa. (Elected Oct. 10, 1927.) (Age 32.) Research Engr., Aluminum Co. of America, Aluminum Research Laboratories, New Kensington, Pa. Refers to H. Cross, E. C. Hartmann, W. C. Huntington, R. G. Sturm, R. L. Templin, W. M. Wilson.

Howe, John Edward, Jun., Rochester, N.Y. (Elected Jan. 16, 1928.) (Age 32.) With Eastman Kodak Co. Refers to C. H. Brown, L. S. Dixon, J. W. Howe, R. G. Lingley, F. A. Marston, R. C. Schwind, E. A. Taylor.

Jennings, George Henry, Jun., San Francisco, Calif. (Elected Dec. 9, 1935.) (Age 32.) Res. Inspector with Golden Gate International Exposition. Refers to C. L. Allen, J. E. Conzelman, J. J. Gould, J. B. Leonard, H. G. Sharp, H. C. Vensano.

Krabbe, Johan Adolph, Jun., The Dalles, Ore. (Elected July 25, 1932.) (Age 32.) Project Engr., Water Facilities, U. S. Dept. of Agriculture. Refers to J. M. Adams, R. D. Gladding, M. Jackson, H. E. Phelps, C. N. Reitze, M. K. Snyder.

Lindeman, Malcolm Daniel, Jun., Chicago, Ill. (Elected July 15, 1929.) (Age 32.) Civ. Engr., Charles C. DeLeuw & Co., acting as Res. Engr. Refers to C. E. DeLeuw, M. I. Evinger, R. O. Green, C. C. Keirle, H. J. Kesner, C. E. Mickey, S. G. Neiler.

Malley, Herbert, Jun., Hartford, Conn. (Elected Jan. 13, 1930.) (Age 32.) Engr. and Manager of Sales, in Connecticut and western Massachusetts, Fitzgibbons Boiler Co. Refers to L. W. Clark, C. W. Freeman, A. H. Greenwood, R. C. Noerr, W. A. D. Wurts.

Martin, Harold Melville, Jun., Denver, Colo. (Elected April 22, 1935.) (Age 30.) Asst. Engr., Grade 11 (Engr.-Foreman), U. S. Bureau of Reclamation. Refers to D. P. Barnes, J. N. Bradley, E. W. Lane, A. Ruettgers, C. A. D. Young.

MINDLIN, RAYMOND DAVID, Jun., New York City. (Elected Jan. 25, 1932.) (Age 32.) Instructor, Dept. of Civ. Eng., Columbia Univ. Refers to B. A. Bakhmeteff, J. K. Finch, W. J. Krefeld, H. M. Westergaard, R. R. Zipprodt.

MOORE, ROBERT JEROME, JR., Jun., El Paso, Tex. (Elected Nov. 14, 1927.) (Age 32.) Draftsman, International Boundry Comm. Refers to E. P. Arneson, C T. Bartlett, L. M. Lawson, J. L. Lytel, J. T. M. Pearson, R. G. White.

RILEY, ELMER DARRELL, Jun., Richland, N.Y. (Elected Oct. 14, 1930.) (Age 32.) With New York State Dept. of Public Works, Div. of Eng., computing and checking accounts on completed contracts in Dist. Office. Refers to F. B. Crocker, E. D. Hendricks, F. D. McKeon, M. B. Palmer, H. G. Throop.

SHATTUCK, WALTER FRANCIS, JR., Jun., Kenilworth, Ill. (Elected Nov. 12, 1928.) (Age 32.) Refers to T. L. Condron, H. Cross, J. H. Prior, T. C. Shedd, A. Smith, I. F. Stern, W. M. Wilson.

SPERLING, ELMER JOHN, Jun., Norris, Tenn. (Elected Oct. 26, 1931.) (Age 32.) Jun. Hydr. Engr., TVA. Refers to C. E. S. Bardsley, H. C. Beckman, J. B. Butler, A. S. Fry, B. G. Harris, G. H. Hickox, P. S. Reinecke.

STOCKBRIDGE, GLENN HENRY, Jun., Bakersfield, Calif. (Elected Oct. 10, 1927.) (Age 32.) Asst. Chf. Engr. in charge of all operations of Eng. and Water Measuring Depts., Kern County Land Co. Refers to H. S. Allen, I. H. Althouse, B. A. Etcheverry, H. L. Haehl, G. L. Henderson, Jr., J. B. Holfelder.

STORY, JOHN WILSON, Jun., Grand Rapids, Mich. (Elected July 15, 1929.) (Age 32.) Constr. Supt. for WPA. Refers to T. D. B. Groner, W. L. Leach, H. H. Moseley, J. P. Reinheimer, G. T. Zala.

STREETER, VICTOR LYLE, Jun., Denver, Colo. (Elected Oct. 26, 1931.) (Age 28.) Asst. Engr., U. S. Bureau of Reclamation, Hydr. Laboratory Sec. Refers to J. N. Bradley, E. L. Eriksen, H. W. King, E. W. Lane, W. H. Nalder, J. C. Stevens, C. O. Wisler.

WAGNER, ALFRED, Jun., Brooklyn, N.Y. (Elected Oct. 14, 1929) (Age 32.) Transitman, Dept. of Docks ,New York City. Refers to O. G. H. Buettner, J. J. Knox, W. J. Krefeld, H. E. Nobes, G. A. Torrey, R. A. Verpillot, C. R. Wyckoff.

The Board of Direction will consider the applications in this list not less than thirty days after date of issue.

Men Available

These items are from information furnished by the Engineering Societies Employment Service, with offices in Chicago, New York, and San Francisco. The Service is available to all members of the contributing societies. A complete statement of the procedure, the location of offices, and the fee is to be found on page 11 of the 1938 Year Book of the Society. To expedite publication, notices should be sent direct to the Employment Service, 31 West 39th Street, New York, N.Y. Employers should address replies to the key number, care of the New York Office, unless the word Chicago or San Francisco follows the key number, when it should be sent to the office designated.

Construction

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 31; B.S. in C.E., 1929; married; 5 years on municipal water works, including earth dam and concrete construction; 4 years in charge of supervision and planning of municipal works program cooperating with federal agencies; special surveying experience; desires position as resident engineer on construction of sewerage or water works. C-420.

CONSTRUCTION ENGINEER; Assoc. M. Am. Soc. C.E.; 48; married; university graduate; registered engineer, California; 25 years experience; 13 years with Metropolitan Water District of Southern California; qualified to take charge of field or office on construction. Connection desired on water supply, power, flood control, or sewer project. Location anywhere. C-421.

CIVIL AND CONSTRUCTION ENGINEER; Jun. Am. Soc. C.E.; 31; single; B.S.C.E., 1930; 6 years construction experience with major contracting firms and municipal, state, and federal engineering departments on bridges, viaducts, highways, and concrete and steel structures as resident engineer and assistant superintendent. Estimating and cost work. Now employed. Available for similar permanent position. C-430.

Design

STRUCTURAL AND HYDRAULIC ENGINEER; Assoc. M. Am. Soc. C.E.; 32; married; B.S.C.E.; prof. C.E. degree; 10 years excellent experience in design of reservoirs, earth dams, canals, hydroplants and appurtenances, irrigation, and a variety of hydraulic structures; bridges and buildings; investigations and estimates. Practical and efficient. Available soon. C-419.

Executive

GRADUATE CIVIL ENGINEER; M. Am. Soc. C.E.; 59; married. Experience on design and construction of railroads, irrigation developments, hydroelectric power plants, dams, and reinforced concrete. Available now. C-417-1-A-18 San Francisco.

Hydraulic

HYDRAULIC ENGINEER; M. Am. Soc. C.E.; Mem., A.S.M.E.; technical school and university studies and degrees; long experience on design, construction, inspection, supervision of hydroelectric developments; desires position anywhere. English, German, Scandinavian languages; fair speaking knowledge of Spanish. C-427.

Junior

GRADUATE CIVIL ENGINEER; 23; class of 1938, Cooper Union Institute of Technology; desires any position in the civil engineering field; some experience as mechanical draftsman in connection with estimating costs for ice plant; pleasant personality, good diction, neat appearance; knowledge of typewriting; salary secondary to opportunity. C-418.

CIVIL ENGINEERING GRADUATE; class of 1937; wishes to have work at least through the winter. Is working as rodman and materials checker for state highway department at present, but the work will soon be discontinued as the project will be completed about the middle of October. C-422.

CIVIL ENGINEER; 26; graduate in administration engineering, 1938. Interested in efficiency and methods. Good student. Able to get along with men. Desires work leading to position of efficiency engineer. Has worked in several industrial organizations, learning something of industrial methods. Location immaterial. C-423.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 27; single; B.S.C.E., Villanova College; 1 1/4 years U. S. Coast and Geodetic Survey—triangulation surveying, State of New Jersey, field and office work; 1 year inspecting and surveying for large deep-water quay terminal project. Desires position in engineering construction; location immaterial; available immediately. C-424.

SANITARY ENGINEER; Jun. Am. Soc. C.E.; 30; single; C.E., University of Cincinnati, 1933; M.S., New York University, 1937; 1 year New York State Department of Health, sanitary surveys, reports on water supplies, sewage-disposal systems; 1 year supervisor, cross-connection survey, sponsored by U. S. Public Health Service; 1 year surveying (mapping); 2 years map drafting (real estate). C-425.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 26; single; B.S. in C.E., Newark College of Engineering, 1933; 1 year as draftsman preparing maps and making necessary computations for flood control study; 3 years as engineer in charge of field party securing field information for flood control study. References; immediately available. C-426.

SANITARY ENGINEER; Jun. Am. Soc. C.E.; 24; single; B.S.C.E., Syracuse University, 1936; experience in laboratory routines, bacterial and chemical analyses of water, cost accounting, and editing technical reports. Desires position in design, operation, or research in water or sewage field; location immaterial; available on short notice. C-428.

GRADUATE CIVIL ENGINEER; Jun. Am. Soc. C.E.; 27; Cornell University; single. Experience includes one year as general contractor's field engineer on housing project; 2 1/2 years estimating for manufacturers of structural steel, water tube boilers and accessory equipment, and welded steel tanks and towers. Desires permanent position with construction firm or manufacturer. C-429.

RECENT BOOKS

New books of interest to Civil Engineers donated by the publishers to the Engineering Societies Library, or to the Society's Reading Room, will be found listed here. A comprehensive statement regarding the service which the Library makes available to members is to be found on page 108 of the Year Book for 1938. The notes regarding the books are taken from the books themselves, and this Society is not responsible for them.

ADVANCED MATHEMATICS FOR ENGINEERS. By H. W. Reddick and F. H. Miller. New York, John Wiley & Sons, 1938. 473 pp., diagrs., charts, tables, 9 × 6 in., cloth, $4.

Differential equations, vector analysis, probability, operational calculus, and the more complex mathematical functions and series are discussed, emphasis being placed on physical applications by illustrating each principal topic by problems relating to civil, electrical, mechanical, and chemical engineering. Definitions, physical laws, theorems, and physical units are presented with particular care.

AIR CONDITIONING. By C. A. Fuller with collaboration of D. Snow. New York, Norman W. Henley Publishing Co., 1938. 577 pp., illus., diagrs., charts, tables, 9 × 6 in., cloth, $4.

In addition to the customary information concerning thermodynamic fundamentals, design of distributing equipment, principles of condensers and evaporators, and descriptions of installations, the subject of codes and ordinances covering air conditioning is discussed. The non-technically trained reader has been primarily considered.

AMERICAN ROAD BUILDERS' ASSOCIATION CONVENTION PROCEEDINGS 1938. Washington (D.C.), American Road Builders' Association, 1938. 917 pp., illus., tables, diagrs., charts, 9 × 6 in., leather, $10 (free to members).

This volume comprises the Proceedings of the thirty-fifth annual convention of the American Road Builders' Association, held in Cleveland, Ohio, in January 1938. Over 100 papers on various phases of highway design, construction, and maintenance are included, and the volume should be valuable to highway engineers, contractors, manufacturers, distributors, and others interested in making highways safer and more adequate.

BERICHTE DES DEUTSCHEN AUSSCHUSSES FÜR STAHLBAU, Ausgabe B, Heft 9: AUS UNTERSUCHUNGEN MIT LEICHTFAHRBAHNDECKEN FÜR STRASSENBRÜCKEN, by O. Graf. Berlin, Julius Springer, 1938. 25 pp., illus., diagrs., charts, tables, 11 × 8 in., paper, 4 rm.

This report gives the results of tests of a number of types of light steel floors for highway bridges.

THE BRUNELS, FATHER AND SON. By C. B. Noble. London, Cobden-Sanderson, 1938

279 pp., illus., diagrs., 9 × 6 in., cloth, 15s.

An account of the lives of two men who contributed some of the most notable engineering feats of the early and middle nineteenth century, including the original Thames tunnel and the Great Eastern steamship. Contains much original material from diaries, letters, etc.

Concrete Manual. Denver (Colo.), U. S. Bureau of Reclamation, 1938. 454 pp., illus., tables, diagrs., charts, 7 × 4½ in., leather, $1 (12 cents extra for postage in foreign countries, except Canada and Mexico).

This manual is a revision and enlargement of a tentative issue prepared in 1936 for the use of Bureau of Reclamation employees. It has been arranged in four general divisions. Part I is devoted to the properties of and requirements for concrete and its ingredients; Part II discusses the field and laboratory investigations of these materials; Part III is related to concrete construction and its control; and Part IV consists of a group of appendixes, including test procedure, mix design, and computation data.

Concrete Pipe in American Sewerage Practice. Prepared and edited by M. W. Loving. Chicago, American Concrete Pipe Association (33 West Grand Avenue), 1938. 174 pp., illus., tables, diagrs., charts, 9 × 6 in., leather.

In this treatise, which is Bulletin 17 of the American Concrete Pipe Association, a number of sewerage improvements in cities of the United States have been described. Special hydraulic subjects have also been considered, as well as the drainage of airports, recommendations for the construction of concrete pipe sewers (in open cut, in tunnel, and by the jacking method), typical subaqueous sewers, force mains, and inverted siphons.

Design of Steel Buildings, 2 ed. By H. D. Hauf. New York, John Wiley & Sons, 1938. 232 pp., diagrs., charts, tables, 9 × 6 in., cloth, $2.75.

General principles of structural-steel design as applied to the commoner types of buildings, with consideration of the various structural units, elements, and stresses that enter into such work. Since the book is intended to be used in conjunction with the structural steel handbooks, it contains but few tables of structural shapes and analogous materials.

Deutsches Museum, Abhandlungen und Berichte, Jg. 10, Heft 1. Elias Holl, der Augsburger Stadt-Werkmeister. By O. Schürer. Berlin, VDI-Verlag, 1938. 28 pp., illus., 8 × 6 in., paper, 0.90 rm.

Elias Holl (1573–1646) was the outstanding architect and builder of his day and the most important representative of the German Renaissance. As municipal engineer for the city of Augsburg, he was responsible for many of its public buildings and other works. This brief biography covers his life and work.

Deutsches Museum, Abhandlungen und Berichte, Jg. 10, Heft 2. Von der Abwasserbeseitigung zur Abwasserverwertung. By H. Kölzow. Berlin, VDI-Verlag, 1938. 31 pp., illus., diagrs., tables, paper, 0.90 rm.

A brief popular account of the problems of sewage disposal and utilization, which describes the methods now in use.

Elements of Water Supply Engineering, 2 ed. By E. L. Waterman. 2 ed. New York, John Wiley & Sons, 1938. 329 pp., illus., diagrs., charts, maps, tables, 9 × 6 in., cloth, $3.50.

The aim of this text is to provide a work upon the fundamentals of the subject which can be covered thoroughly in the time usually allotted to courses in civil engineering. The topics are arranged in the order in which they appear in the development of a system, the public water supply being followed from source to customer.

Engineering Terminology, Definitions of Technical Words and Phrases. By V. J. Brown and D. G. Runner. Chicago, Gillette Publishing Co., 1938. 310 pp., illus., diagrs., 9 × 6 in., cloth, $3.50.

A list of terms often used in technical writing and specifications, with definitions obtained from the usage of various trade and engineering organizations. The terms apply especially to civil engineering and architecture. In addition, the book contains a concise Spanish-English and English-Spanish dictionary of highway terms, a brief German-English dictionary of terms for mineral aggregates, and several tables of technical symbols, abbreviations, conversion factors, etc.

Fluid Mechanics for Hydraulic Engineers. (Engineering Societies Monographs.) By H. Rouse. New York and London, McGraw-Hill Book Co., 1938. 422 pp., illus., diagrs., charts, tables, 9 × 6 in., cloth, $5.

Intended specifically for graduate students and practicing engineers, this volume presents in systematic detail the fundamental principles of fluid motion and their application to various phases of hydraulic engineering. Emphasis is placed upon sound physical analysis of actual flow phenomena, in the effort to provide more dependable methods of approach than empirical hydraulics can afford.

Great Britain. Dept. of Scientific and Industrial Research. Road Research Technical Paper No. 5. The Grading of Aggregates and Workability of Concrete. London, His Majesty's Stationery Office; (obtainable from British Library of Information, 270 Madison Ave., New York City), 1938. 42 pp., illus., diagrs., charts, tables, paper, 45 cents.

Gives the results of an investigation of the effect of the grading of the aggregate upon the strength and workability of concrete. A new conception of workability is given, a method for measuring it is described, and a wide range of cement contents, aggregate gradings, and types is examined.

Road Traffic and Its Control. (Roadmakers' Library.) By H. A. Tripp. London, Edward Arnold & Co.; New York, Longmans, Green & Co., 1938. 414 pp., diagrs., charts, tables, 9 × 6 in., cloth, $10.

This volume presents an unusually comprehensive survey of traffic problem by the assistant commissioner of police, Scotland Yard, in charge of traffic. Traffic control by law and police, the development of traffic policy, control by construction and mechanical appliances, road transport, and road casualties are discussed clearly and in considerable detail, with attention to the problems of legislation, public opinion, psychology, and town planning that are involved. Although written for British conditions, the book has much of interest to other countries.

(The) Rôle of Scientific Societies in the Seventeenth Century. By M. Ornstein. Chicago, University of Chicago Press, 1938. 308 pp., illus., tables, 9 × 6 in., cardboard, $3.

An interesting and valuable contribution to the history of science, which calls attention especially to the ways in which scientific development was aided by the scientific societies of the seventeenth century. It also contains valuable accounts of the work of many famous scientists of the period and a description of the scientific work of the universities. There is a bibliography. The new edition retains the text of the original and also includes numerous illustrations.

Route Surveys. By Harry Rubey. New York, The Macmillan Company, 1938. 549 pp. (including 261 pp. of tables), illus., diagrs., charts, 7 × 4½ in., leather, $3.75.

The author of this handbook believes that the continuance of civilization depends largely on adequate transportation and communication. In this volume he has included material on the survey, design, and construction of railways, highways, canals, flumes, levees, pipe lines, transmission lines, and other route constructions. The second part of the book consists of tables, which have been arranged to facilitate use and to cover the wide range of requirements of the civil engineer in a changing world.

Soil Mechanics Applied to Highway Engineering in Ohio. (Engineering Experiment Station Bulletin No. 99) By K. B. Woods and R. R. Litehiser. Columbus (Ohio), Ohio State University, July 1938. 66 pp., illus., tables, diagrs., charts, 9 × 6 in., paper, 50 cents.

This bulletin treats of the status of the present practice of field and laboratory soil investigations and the use made of such investigations in the design, construction, and maintenance of the highways of Ohio.

Street Cleaning Practice. By the Committee on Street Cleaning. Chicago, American Public Works Association (1313 East 60th Street), 1938. 407 pp., illus., tables, diagrs., charts, 9 x 6 in., cloth, $4.

The result of over two years' work on the part of the Association, this volume provides a long-needed and authoritative treatise on street cleaning. The committee gives a comprehensive view of the problem, followed by an analysis of methods and consideration of problems of administration.

Strength of Materials. By N. C. Riggs and M. M. Frocht. New York, Ronald Press Co., 1938. 432 pp., illus., diagrs., charts, tables, 9 × 6 in., cloth, $3.75.

This book is intended for use in a first course in the subject and is designed for students with a knowledge of calculus and the fundamentals of statics. Unusual features are a brief treatment of the theory and application of photoelasticity to the study of stresses, and the inclusion of curves giving the factors of stress concentration. The authors have endeavored to produce a unified, teachable text which stresses fundamental principles and illustrates the applications of the theory by numerous practical problems.

Structural Aluminum Handbook. Pittsburgh (Pa.), Aluminum Company of America, 1938. 211 pp., diagrs., tables, 9 × 6 in., leather, $1.25.

This handbook gives the fundamental data concerning the ultimate strength of aluminum-alloy structural members. The characteristics, manufacture, and fabrication of structural products are described, and the design of structures is discussed. The properties of elements of sections for structural shapes are tabulated, and specifications, tolerances, and commercial sizes are given.

Structural Design. By C. T. Bishop. New York, John Wiley & Sons, 1938. 254 pp., illus., diagrs., charts, tables, 9 × 6 in., cloth, $3.50.

This book is intended for basic courses in the design of steel structures. The fundamental principles of design are first applied to detached individual members without regard to their relation to other members in a structure—a plan that enables the student to concentrate his attention upon the few new principles involved in each case. The application of these principles is then illustrated by the design of interconnected members of typical structures.

Structural Design. By H. Sutherland and H. L. Bowman. New York, John Wiley & Sons, 1938. 402 pp., diagrs., charts, tables, plates, 9 × 6 in., cloth, $4.50.

This is a college text covering the fundamentals of the theory and practice of design in steel and timber. The first four chapters and Appendix A contain an amplified résumé of the important considerations met with in the strength of materials course, the remaining chapters apply these fundamentals to common structures, and the remaining appendixes provide specifications and design data.

Structure of Steel. By E. N. Simons and E. Gregory, with an introduction by F. C. Lea. New York, Prentice-Hall, 1938. 115 pp., illus., diagrs., charts, tables, 8 × 5 in., cloth, $2.

A simple, non-technical explanation of the structure of steel, considering the various combinations of iron with carbon and other alloying constituents, the properties of the various internal structures, with the methods and heat treatments used to produce them, and brief information on corrosion and X-ray examination.

Studies on the Periodicity of Earthquakes. By C. Davison. London, Thomas Murby & Co., 1938. 107 pp., charts, tables, 9 × 6 in., cloth, 13s. 6d.

Dr. Davison has here summarized and thoroughly revised the various articles on the periodicity of earthquakes which he has published during more than forty years. The bearing of these studies upon movements of the earth's crust is discussed.

Technical Progress and Unemployment. Studies and Reports, Series C (Employment and Unemployment) No. 22. By E. Lederer. Geneva (Switzerland, International Labor Office), 1938. 267 pp., tables, 10 × 7 in., paper, $1.50 (obtainable from United States branch, Washington, D. C.).

This study is an analysis of the social and economic effects of technical progress, especially on enemployment and on the formation of capital. The author discusses the various forms of technical progress, the concept of technological unemployment, increasing and diminishing return, the equilibrium of the labor market, the effects of technical progress on the economic system and the labor and capital market, the elasticity of modern monetary systems, technical improvements and the business cycle, and capital-saving technical improvements.

Thermodynamics, Fluid Flow, and Heat Transmission. By H. O. Croft. New York and London, McGraw-Hill Book Co., 1938. 312 pp., diagrs., charts, tables, 9 × 6 in., cloth, $3.50.

The purpose of this textbook is to review thermodynamics, introduce dimensional-analysis, fluid-flow, and heat-transmission problems, and to combine this material into one continuous study covering fields of engineering knowledge encountered in actual problems. An elementary knowledge of thermodynamics and hydraulics is assumed.

VDI-Jahrbuch 1938. Die Chronik der Technik, edited by A. Leitner of VDI. Berlin, VDI-Verlag, 1938. 312 pp., 8 × 6 in., paper, 3.50 rm.

This yearbook contains nearly one hundred reports by as many specialists, upon the developments in various branches of engineering and technology during the year 1937. The reports are accompanied by references to about ten thousand books and articles, thus making accessible a large amount of information on every topic. An extensive index adds to the value of the work.

William Tyrrell of Weston. By E. L. Morrison and J. E. Middleton. Toronto and New York, (The) Macmillan Co., 1937. 152 pp., illus., 9 × 6 in., cloth, $3.

The story of a young Irishman who went to Canada in the early nineteenth century and built up a considerable reputation as an architect and builder, bridge engineer, surveyor, geologist, expert in municipal affairs, magistrate, and gentleman.

CURRENT PERIODICAL LITERATURE

Abstracts of Articles on Civil Engineering Subjects from Magazines in This Country and in Foreign Lands

Selected items from the current Civil Engineering Group of the Engineering Index Service, 29 West 39th Street, New York, N.Y. Every article indexed is on file in The Engineering Societies Library, one of the leading technical libraries of the world. Some 2,000 technical publications from 40 countries in 20 languages are received by the Library and are read, abstracted, and indexed by trained engineers. With the information given in the items which follow, you may obtain the article from your own file, from your local library, or direct from the publisher. Photoprints will be supplied by this library at the cost of reproduction, 25 cents per page, plus postage, or technical translations of the complete text may be obtained at cost.

BRIDGES

Bascule, Strengthening. Réparation et Renforcement du pont tournant de Brest, Lecomite. *Annales des Ponts et Chaussees*, vol. 108, no. 5, May 1938, pp. 629–673. Methods used in strengthening of old bascule bridge at Brest, France, having maximum leaf span 58.3 m; use of welding methods; bringing operating machinery up to date.

Concrete Arch, Ohio. High Level Bridge Corrects Bad Alignment. *Eng. News-Rec.*, vol. 121, no. 4, July 28, 1938, pp. 110–112. Design and construction of reinforced concrete highway bridge consisting principally of 6 spans 155 ft to 175 ft in length, over Little Miami River at Fosters Crossing, Ohio, eliminating dangerous railroad crossing and replacing bad section of trunk highway.

Concrete, Tacoma, Wash. High Concrete Bridge for Low Cost, E. A. White. *Eng. News-Rec.*, vol. 121, no. 9, Sept. 1, 1938, pp. 265–267. Description of recently completed Gehring road bridge, near Tacoma, Wash., 264 ft long, maximum span 90 ft, featuring concrete bents 90 ft high and hollow-type construction throughout; deck forms and concreting; cost amounted to $84 per lin ft.

Highway, Design. Modern Highway Bridge, L. C. Hollister. *Road & Streets*, vol. 80, no. 10, Oct. 1937, pp. 45–51. Architectural and engineering features of modern highway bridges as exemplified by recent designs of California Division of Highways.

Highway, Montana. Continuous Bridge Approved, V. P. Maun. *Eng. News-Rec.*, vol. 121, no. 6, Aug. 11, 1938, p. 186. Acceptance of continuous girder type of bridge by Montana Highway Department on account of its special advantages with regard to appearance and economy.

Highway, St. Lawrence River. Five Bridges in One. *Eng. News-Rec.*, vol. 121, no. 8, Aug. 25, 1938, pp. 231–234. History, design, and construction of Thousand Islands Bridge structures over St. Lawrence River, consisting of two suspension bridges, steel arch, continuous truss, and rigid-frame concrete spans, totaling about 8,000 ft in length.

Plate Girder, Denmark. Die Storstrombruecke, G. Schaper. *Bautechnik*, vol. 15, no. 53, Dec. 10, 1937, pp. 691–698. Report on design and construction features of plate girder and steel arch combined highway and railroad bridge over Storstrom, Denmark. Similar in contents to several previously indexed articles. See *Engineering Index*, 1937, p. 155.

Steel Arch, Connecticut. Balanced Cantilever Erection of Twin Tied Arches, L. F. Kirkley. *Eng. News-Rec.*, vol. 121, no. 8, Aug. 25, 1938, pp. 236–240. Design and construction of recently completed highway bridge over Connecticut River, between Middletown and Portland, Conn., consisting of two 600-ft three-hinged tied arches and plate-girder approaches, total length 3,420 ft; cable tieback system; reeving and adjusting cables; jacking; closing of arch spans.

Steel Arch, Failure. Collapse of Falls View Bridge, P. L. Pratley. *Eng. J.*, vol. 21, no. 8, Aug. 1938, pp. 375–381. Analysis of causes that brought about failure of Falls View steel arch bridge over Niagara River; unusual ice conditions that brought about disaster, and action of bridge under abnormal strain. Before Am. Assn. Advancement Science.

Steel, Great Britain. Rapid Bridge Erection. *Ry. Gaz.*, vol. 68, no. 22, June 3, 1938, pp. 1070–1071. Special problems overcome in erection of 5-span steel bridge over LMSR and canal near Derby; bridge is 260 ft 4 in. long on center line, with width of 80 ft between parapet walls, and has two footpaths, two cycle tracks, two 20-ft roads, and center island; total weight of steel work 610 tons.

Steel Truss, China. Chien Tang Bridge, China. *Ry. Gaz.*, vol. 68, no. 15, Apr. 15, 1938, pp. 756–758. Construction of double-decked bridge with road over single line of railway; main spans are Chromador steel Warren trusses; there are eight 27-ft panels in each girder; reinforced piers supported by pneumatic caissons.

Steel Truss, St. Clair River. Economy and Good Appearance Rule Cantilever Design. *Eng. News-Rec.*, vol. 121, no. 8, Aug. 25, 1938, pp. 234–236. Design and construction of Bluewater curved steel-truss cantilever bridge over St. Clair River, between Port Huron, Mich., and Sarnia, Ontario, totaling about 6,000 ft in length, including approaches; main span is 871 ft long.

Steel Truss, Vierendeel. Brittle Steel Feature of Belgian Bridge Failure, O. Bondy. *Eng. News-Rec.*, vol. 121, no. 7, Aug. 18, 1938, pp. 204–206. Author's inferences of cause of collapse of welded Vierendeel truss bridge of 245-ft span over Albert Canal near Hasselt, Belgium; quality of steel; examination of fractures showing brittle steel.

Suspension. Haengebruecken ueber mehrere Oeffnungen, F. Behny. *Bautechnik*, vol. 15, no. 53, Dec. 10, 1937, pp. 709–715. Principle of design of multiple-span suspension bridge; review of French practice; proposed standards of simple suspension bridges.

Suspension, Australia. Three Span Light Suspension Bridge Over Hastings River at Kindee Crossing, N.S.W., V. Karmalsky and A. T. Britton. *Instn. Engrs. Australia—J.*, vol. 9, no. 12, Dec. 1937, pp. 463–471. Description of new suspension bridge consisting of three spans, 88 ft, 220 ft, and 88 ft, respectively, recently constructed by Department of Main Roads, New South Wales; trussed cable design adopted as most advantageous type under condition; details of cables and other parts of structure.

Viaducts, Germany. Die Reichsautobahnbruecken ueber das Hirschfeldtal bei Nossen und das Luetzelbachtal bei Frankenberg, E. Weiss. *Bautechnik*, vol. 15, no. 49, Nov. 12, 1937, pp. 637–643. Design and construction of two plate-girder twin viaducts within new superhighway system of Germany—one at Nossen, consisting of 5 spans 28.5 to 33.2 m in length, and other at Frankenberg, consisting of 3 spans 38.8 to 48.5 m in length.

Wooden. Three Modern Timber Highway Bridges, I. D. S. Kelly and F. P. Cartwright. *Roads & Streets*, vol. 80, no. 11, Nov. 1937, pp. 45–47. Features of Albemarle Sound bridge, North Carolina, 18,000 ft long; new Shriner's Mill bridge in Union County, Pennsylvania, consisting of two 91-ft 6-in. creosote-treated timber spans, and Hancock-Greenfield bridge of 84-ft span, between towns of Hancock and Greenfield, N.H.

BUILDINGS

Concrete, Expansion Joints. Crack Control in Concrete Walls, A. M. Young. *Eng. News-Rec.*, vol. 121, no. 6, Aug. 11, 1938, pp. 178–179. Principle of dummy joints, used in concrete pavement, applied to control of crack formation in exterior concrete walls of high school at Bellingham, Wash.

France. Bureau de tri postal de la gare Saint-Lazare, à Paris, Azema. *Travaux*, vol. 22, no. 66, June 1938, pp. 245–250. Structural features of 4-story reinforced concrete mail-sorting building at Saint-Lazare station, Paris, France, with special reference to design of foundation.

CITY AND REGIONAL PLANNING

United States. Future of State Planning. Report to Advisory Committee by State Planning Review Group. Washington, D.C., U. S. Govt. Printing Office, Nat. Resources Committee, Mar. 1938, 117 pp., 25 cents. Report reviewing status of regional planning in United States; development and present status of state planning; functions and opportunities of state planning boards; relationships of National Resources Committee and state planning boards; directory of members of state planning boards and bibliography of publications.

United States. Regional Planning. Pt. VI—Rio Grande Joint Investigation in Upper Rio Grande Basin in Colorado, New Mexico, and Texas 1936–1937. Washington, D.C., Nat. Resources Committee, Feb. 1938, 2 vols. (Vol. I, 566 pp.; Vol. II, maps); tables, diagrs., $3.50. Hydrological and other data to serve as basis for development of water resources of Upper Rio Grande Basin; water uses and requirements; storage development; additional water supplies by importation and salvage; precipitation, evaporation, and stream flow records. Bibliography.

CONCRETE

Construction. Cement Gun Work, T. W. Moran. *Structural Engr.*, vol. 16, no. 9, Sept. 1938, pp. 274–286. History of cement gun and gunite concrete; examples of application of gunite to various types of engineering work in Great Britain, including lining of tunnels and strengthening of bridges and other structures.

Construction, Vibrating. Long Continued Vibration Reduces Concrete Strength, W. B. Ivie. *Eng. News-Rec.*, vol. 121, no. 9, Sept. 1, 1938, p. 255. Results of experimental investigation in connection with concrete of Lock No. 24 on Mississippi River at Clarksville, Mo., indicating that long-continued vibration has tendency to cause segregation of materials in concrete with consequent weakening of upper portion and strengthening of bottom portion.

Disintegration. Resistance of Cement to Attack by Sea-water and Alkali Salts, T. E. Stanton, Jr., and L. C. Meder. *Cement & Lime Manufacture*, vol. 11, no. 8, Aug. 1938, pp. 181–182. Abstract of paper previously indexed from *Am. Concrete Inst.—J.*, Mar.-Apr. 1938.

Houses. Latest Developments in Building Concrete Houses, A. L. Rehnquist. *Construction Methods & Equipment*, vol. 19, no. 9, Sept. 1937, pp. 50–53. Review of recent designs, methods of construction, and cost data; form costs for solid walls; ribbed wall construction.

Shafts, Lining. Le revètement, en béton à précontrainte, système Freyssinet, des puits en terrains aquifères, notamment des puits congelés, K. W. Mautner. *Revue Universelle des Mines*, vol. 14, no. 3, Mar. 1938, pp. 291–298. Use of Freyssinet pre-stressed concrete for lining of wells and shafts in water-bearing strata. Bibliography.

CONSTRUCTION INDUSTRY

Equipment. Planning and Plant for Heavy Construction—22, A. J. Ackerman and C. H. Locher. *Construction Methods & Equipment*, vol. 19, no. 10, Oct. 1937, pp. 62–66. Water supply, concrete mixing, and transfer equipment; water requirements for large project; standard large-size concrete mixers; diagram of functions and instructions for operating concrete-mixing plant at Norris Dam; transfer of concrete; concrete pumping.

Equipment. Planning and Plant for Heavy Construction—24, A. J. Ackerman and C. H. Locher. *Construction Methods & Equipment*, vol. 19, no. 12, Dec. 1937, pp. 58–63. Canals, tunnels, and penstocks; construction and lining of canals and cut-and-cover conduits; tunnel driving; drilling and mucking; hauling of muck; ventilation and drainage; shield driving of tunnels; lining of tunnels; equipment for placing tunnel lining.

DAMS

Arizona. Construction of World's Highest Multiple Arch Dam, W. A. Dexhainer. *Reclamation Era*, vol. 28, no. 8, Aug. 1938, pp. 158–162. Construction of Bartlett multiple-arch dam in Arizona, 286.5 ft maximum height, consisting of 9 hollow concrete buttresses with gravity section at each end and 10 reinforced concrete arches; steel forms; fault zones; uses of "Pumpcrete" pipe.